# INTER AVIA

*Review of World Aviation*

*In this Issue:*


**The world at the Crossroads**

**Wonder weapons or Transport Aircraft ? — Four-Engined Airliners**

S. Bangs : F-80 Indoctrination — E. Saenger : Jet Reaction Flight

A Short Guide to Air Navigation — Northrop XF-89

1948 S.B.A.C. Display in Retrospect



VOLUME III  No 11  NOVEMBER, 1948

Consolidated Vultee's new Convair-Liner is scheduled to go into operation with 12 great airlines serving nearly every corner of the globe. Carrying 40 passengers in comfort at 300 miles an hour, it is one of the latest post-war airliners. Like the majority of aircraft all over the world, the Convair-Liners use United Aircraft equipment. *All* of the airlines have specified Pratt & Whitney Double Wasp engines —the majority have also chosen Hamilton Standard Hydromatic propellers.

| | |
|---|---|
| American Airlines | O |
| Continental Air Lines | O√ |
| Central Air Transport Corp. | O |
| FAMA | O√ |
| KLM | O√ |
| Northeast Airlines | O√ |
| Orient Air | O√ |
| Pan American World Airways | O√ |
| Sabena | O√ |
| Swissair | O |
| Trans-Australian Airways | O√ |
| Western Air Lines | O√ |

O = PRATT & WHITNEY engines
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# INTERAVIA

*Review of World Aviation*

OFFICIAL ORGAN OF THE FÉDÉRATION AÉRONAUTIQUE INTERNATIONALE (F.A.I.)

Volume III — November, 1948 — No. 11

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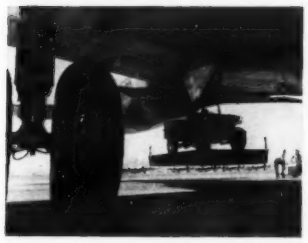
## Contents


| | | |
|---|---|---|
| **The World at the Crossroads** | | **601** |
| **War means... Blood, Sweat and Tears** | | **605** |
| **Fly-Weight** | | **609** |
| **"The works..."** | SCHOLER BANGS | **610** |
| **Northrop XF-89** | | **614** |
| **Rio de Janeiro-Zurich** | | **616** |
| **The Prospects of Jet Reaction Flight (III)** | Dr. E. SAENGER | **617** |
| **Recent Developments in Aeronautical Engineering** | N. S. CURREY | **623** |
| **A Short Guide to Radio Aids used in Air Navigation** | | **626** |
| **Four-Engined Commercial Transports** | | **629** |
| **U. S. Air Force Day in Germany** | | **635** |
| **The 1948 S.B.A.C. Display in Retrospect** | | **636** |
| **Social Conflicts in the French Aeronautical Industry** | | **639** |
| **Official Bulletin of the F.A.I.** | | **641** |
| **The Month in Review** | | **642** |
| **Marginal Notes** | | **644** |

*Front cover :*

*A U. S. Army jeep being hoisted aboard a Douglas C-74 "Globemaster."*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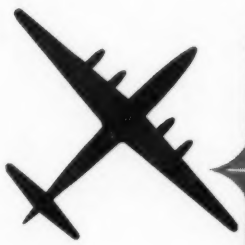

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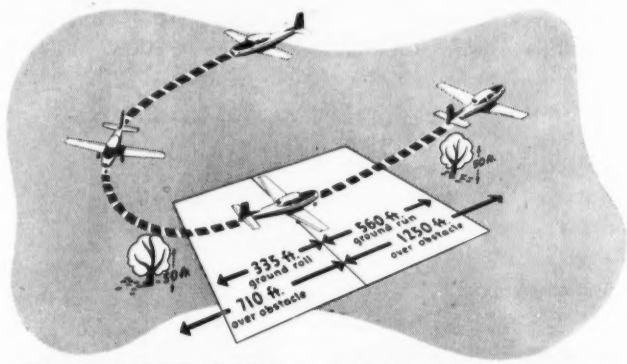


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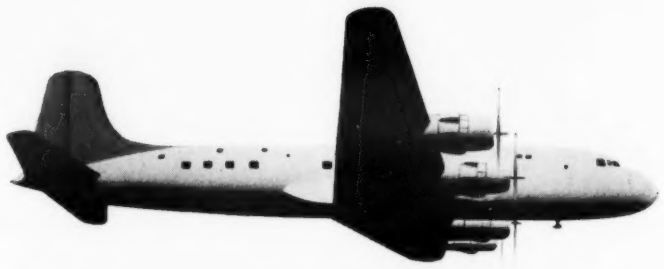

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Some Short jottings for airline operators, charter companies and V. I. P. s

# WHAT THE PRESS IS SAYING OF FLYING BOATS

## *Flying boat opens land route*

### Elephants move to let plane land

By BASIL CARDEW

JOHANNESBURG, Sunday.

A trip that started in Southampton Water finished after five days yesterday in a £1,000,000 reservoir outside Johannesburg — journey's end for Britain's newest flying-boat service over a land-locked route through the heart of Africa.

Captain Edward Rotheram, skippering the 35-ton Springbok Solent in its final proving run, put down on lakes and rivers on the 6,352-mile trail from Britain.

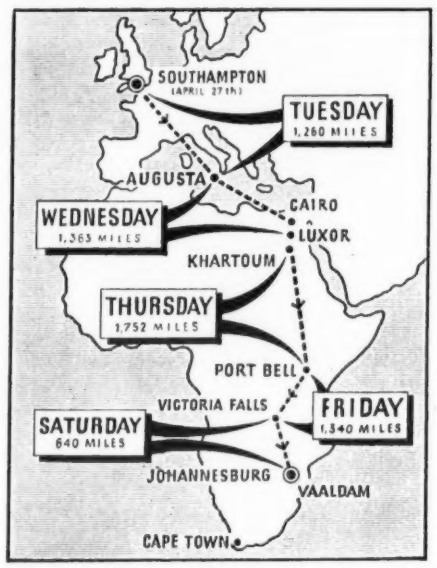
We were the first flying boat ever to "land" on the flooded Zambesi, four miles above the 400-ft. Victoria Falls.

To make that possible, two herds of elephants had to be driven from their favourite watering-place...

#### All mod. con.

The 31 passengers with me on the proving flight looked down from the two-deck plane on fleeing herds of elephants, on the country of the lion and the hippopotamus, on the crocodile swamps of equatorial Africa.

Inside the plane, cruising at 200 miles an hour over forest, scrub, and veldt, there were snug cabins, hot and cold water, a library, and the inevitable chromed cocktail bar. But this was customerless, because the service from three stewards made it unnecessary to leave one's seat...

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## *"Give us flying boats every time" they say*

"For speed, comfort, and ideal flying and sightseeing conditions give us the flying boat every time." This was the unanimous opinion of the "pre-view" party of 34 experienced British journalists and representatives of travel agencies who passed through Cairo yesterday on their way to South Africa in the Short Bros. "Solent."

Veteran journalists were enthusiastic about the trip. All agreed it was a fascinating form of travel and were eagerly looking forward to the stop at Luxor, the flight over central Africa, and a short stay in South Africa...

The route which the Solents are to fly will be from Southampton to Augusta (Sicily) for the first night stop and thence to Cairo and Luxor, the second night stop, where passengers have an opportunity to visit the antiquities.

From Luxor the flying boats will cross the Sudan via Khartoum to Port Bell, on the north shore of Lake Victoria, for another night stop.

Then comes a 1,300-mile journey southwards across Lake Victoria, Tanganyika and Northern Rhodesia to the next alighting place and night stop, near the famous Victoria Falls on the river Zambesi. The last stage of the flight follows across Southern Rhodesia to Vaaldam, the Johannesburg terminal.

*Reprinted by permission of Egyptian Gazette*

NEWS CHRONICLE

## New Worlds

THE possibility of world touring by seaplane opens up attractive prospects for British civil aviation. To travel by air has been, up to date, the resort of the man who was bent—single-mindedly and a trifle grimly—upon reaching his destination in the shortest space of time. But to most of us, more leisured or less intent, to travel remains quite as important as to arrive.

For people who are so minded the flying boat, with its greater comfort and its more leisurely schedule, which allows something more than a mere glimpse of foreign parts, has attractions which the land plane cannot offer.

B.O.A.C. are well equipped to turn these attractions into a good commercial proposition. In Britain we have more experience than any other nation in operating flying boats. Now that a new route has been opened to South Africa, we have proved facilities for such craft extending for more than twenty thousand miles across the world. A very prosperous luxury touring trade can be ours for the taking.

We can only take it, however, when that can be done without damaging our services on the fast commercial routes. Hitherto our flying boats have been employed in eking out as best they can our meagre resources in long-distance land planes. We cannot take on new commitments until B.O.A.C. have been equipped with a fleet of airliners which will enable them to meet all competition on the normal air routes of the world.

The new hopes of the flying boats, then, are only added reasons why no efforts should be spared to build up, by purchase and construction, that great strength of British civil aviation which has been promised for so long, but which is so endlessly delayed in the achievement.

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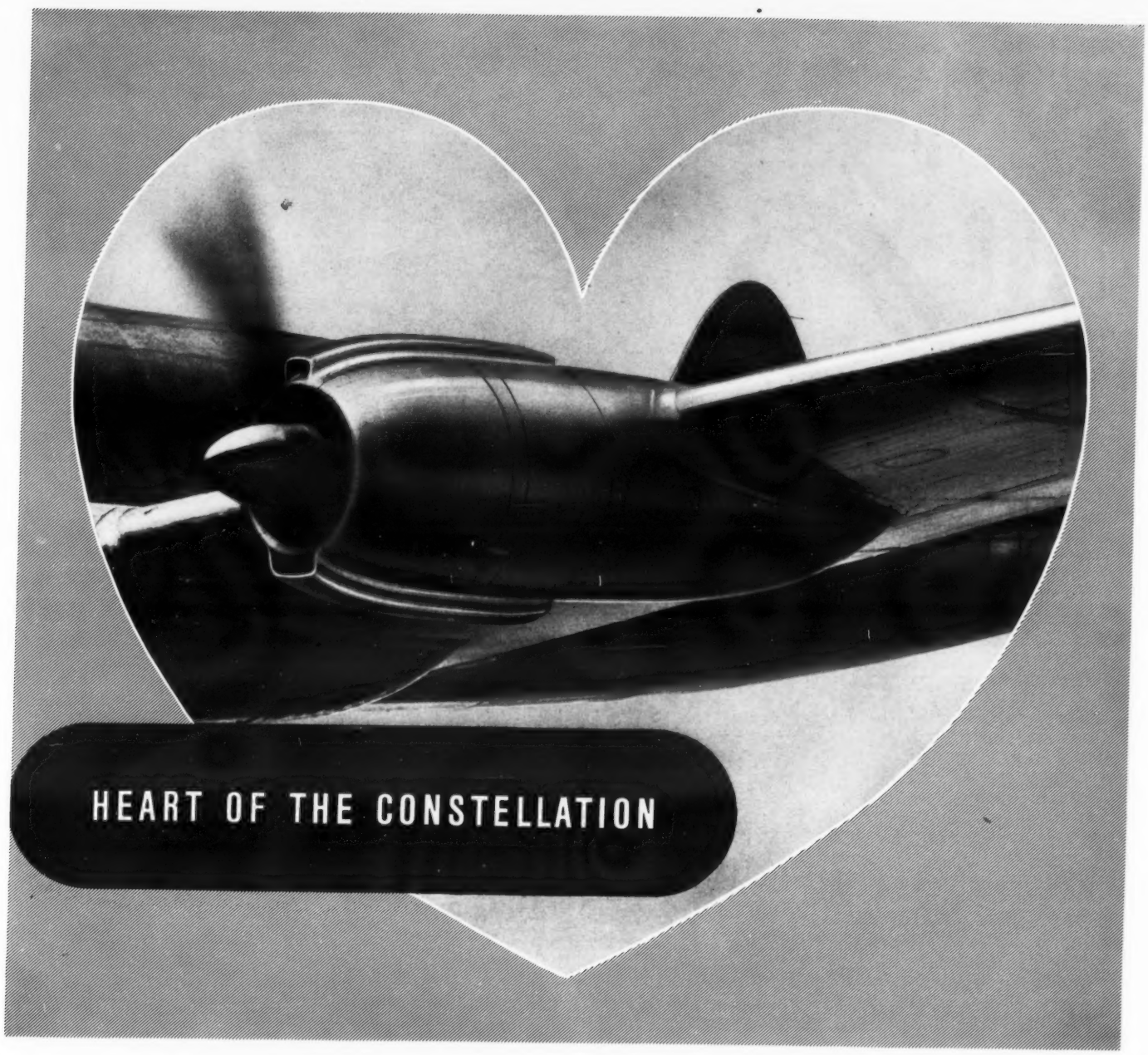

## HEART OF THE CONSTELLATION

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▶ ...over 1,300,000 airline flight hours

▶ ...over 350,000,000 miles in the modern Lockheed Constellation transport alone

▶ In addition to unmatched power, the Cyclone 18BD embodies the following advanced features for greater operating efficiency, economy and stamina :

▶ ...*fuel injection*—for improved fuel economy, better cooling characteristics, and the elimination of induction icing.

▶ ...*low tension ignition*—(high voltage circuits confined to very short leads) for more reliable ignition under all weather conditions and at extreme altitudes, less radio interference, and easier maintenance.

▶ ...*forged aluminum cylinder head and steel barrel with aluminum fins*—for increased strength, less cooling requirements, and lower maintenance costs.

▶ ...*forged steel crankcases*—for increased reliability, elimination of studs, and less maintenance.

▶ No engine in its power range has proved its reliability so thoroughly in airline service as the Wright Cyclone 18BD.

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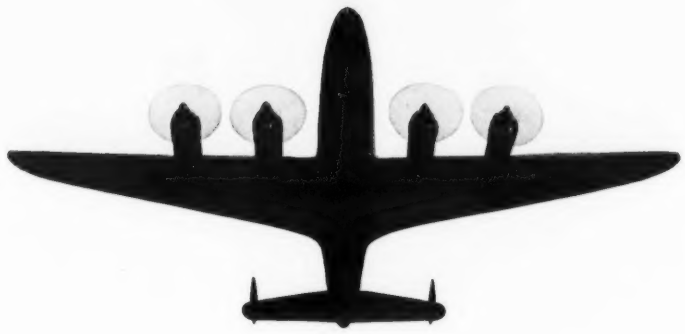

# Lockheed Constellation

## 2 to 1

## *Across the Atlantic*

The famous Lockheed Constellation every month carries twice as many passengers across the North and South Atlantic as all other types of aircraft combined, according to recent U. S. Government reports. This is clear evidence of passenger and airlines preference for the Constellation. It is also clear evidence of the Constellation's superiority in range and operating efficiency.*

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** The Constellation is the most tried and proven of high-altitude transports. It has flown more than three thousand million passenger miles in world-wide service on 12 leading airlines.*

# The World at the Crossroads

We arrived home in Geneva on our way back from Brussels. From September 14th to 18th, a "miniature parliament" of international aviation had met in Brussels—the Fourth Annual Meeting of the International Air Transport Association. The big men of commercial aviation from all over the world, accompanied by their staffs, convened, exchanged frequently conflicting opinions, and thus gave UNO, which had been meeting in Paris since September 21st, a reduced-scale example of what international co-operation means.

Sir William P. Hildred, Director-General of IATA, seized on this occasion to speak, in his usual lively manner, of his worries and hopes to the representatives of the 68 airline companies in his Association. In order to illustrate the humiliations and frustrations confronting international airline passengers, he quoted a paragraph from an article by J. B. Priestley, the English playright :

"There is no place that offers more of the tragedy and screaming irony of our age than an international airport. Above, waiting for you, is the wide blue sky, the freest element through which Man has ever travelled. But within the squat buildings on the ground, not only is there no suggestion of this spaciousness and freedom, but you appear to wait apprehensively in the shadow of the Grand Inquisitor himself. ...Every bit of paper we clutched so stickily was checked and double-checked. We were herded from pen to pen like a bunch of cattle marked for slaughter. Our dignity as human beings was obliterated. We were really bits of paper with heavy lumps of sweaty flesh attached to them. Nobody hinted that we were the people who paid for all this herding, penning, checking and stamping. I tried to think back to 35 years ago when, as a careless youth, I visited five foreign countries in turn without a document of any sort, without telling anybody where I was travelling or where I was born. Such a youth today would imagine that he had wandered into a world of lunatics. And then I realised that the true horror of the situation was that we were taking all this profound barbarism for granted—treated like sheep because we were turning into sheep."

The public wait for the customs officer.

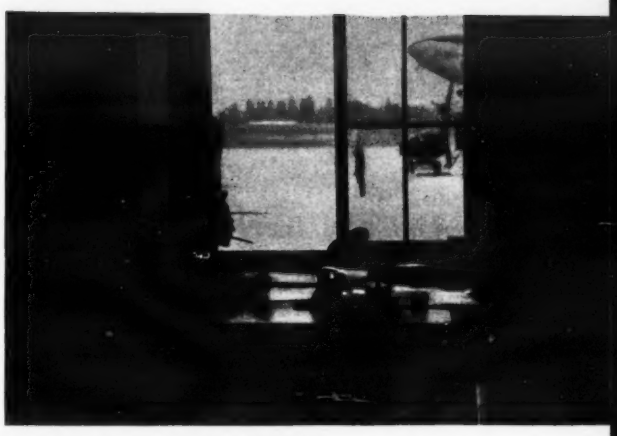
Meanwhile, Sir William also stressed the great efforts made by the International Civil Aviation Organisation and his own Association to facilitate air transport. Indeed, the word "Facilitation" has become a motto ; ICAO has its own special Facilitation Division, and both these international bodies have strongly endorsed the so-called FAL programme. What has been achieved so far ?

*

As I said before, we arrived home in Geneva on our way back from the IATA Meeting in Brussels.

Now I feel quite at home on airports, and especially on my own airport at Geneva. The staff there, whether they be airline officials, police or customs officers, know perfectly well that my profession requires that I travel by air very often, that my papers are invariably in order, that I am not in the habit of smuggling gold bars or narcotics ; briefly, that I have no desire to trick them in any way. And I must add that I have often admired the understanding attitude of these officials towards the clock-conscious airline passengers. Often, but not always. I must add, furthermore, that the French-speaking Swiss personnel in Geneva are generally very intelligent and work smoothly. The Genevese are nimble-witted, Switzerland is a tourist centre, and there has never been any lack of official regulations concerning courtesy to visitors.

However, it was not my lucky day. I experienced a disappointment and I was given a lesson. And Priestley's indignation seemed to loom up before me.



The customs officer waits for the public.

I was accosted by a brand new, young customs officer. The usual questions : where from and where to ? The appropriate answers. All luggage opened and thoroughly examined. The young man grasped hold of a shoe bag. What was in it ? Shoes... Where did you buy them ? In Geneva... Prove it ! I showed him that the shoes had been worn. Yes, but didn't you buy them in Brussels ? Once again I answered in the negative. How can you prove it ? Luckily for me, my shoemaker in Geneva stamps his name inside, as well as the date on which he sells the shoes—just as a precautionary measure for such events. The customs officer had lost the battle, but he did not give up the fight.

It was my colleague's turn next. The game started again. Did you buy anything in Brussels ? Have you anything to declare ? No ! Once more, suitcases were opened and thoroughly searched. With a gleam in his eye, our customs officer grunted his satisfaction as he pounced on a few magazines, which happened to be copies of our own publication. My colleague was flatly accused of giving wrong information. The magazines were gathered together and shown to the head customs officer. A culprit at last. His offer to clarify the misunderstanding and to point out that the magazines were printed in Switzerland, was refused. After a few angry words, the head customs officer, presumably aware of the overgreat zeal of his subordinate, finally handed the magazines back. My colleague was told that they were willing to make an exception. But he had no desire to be treated as an exception. He wanted to pay the customs

Getting warmer...

duty and to have a receipt, a tangible document which could be reprinted. Retorted the customs officer: "Pas de chantage—you can't blackmail us—we can't be bothered with what you want to reprint." It's a pity. However, here you have the story; incidentally, the man wasted half an hour of our time.

You see—the case is not tragic, it is merely typical.

The airline passenger pays an actual increase in tariff for a theoretical increase in speed. During the flight proper, he can usually cash in on the time gain he has paid for. During the departure and arrival, however, it often happens that he wastes valuable time because of the lack of understanding or the exaggerated zeal of an international body of bureaucrats.

It is quite obvious that these officials are obliged to prevent the smuggling of currency, bonds, certain articles and superfluous luxuries, and nobody has the right to utter a word of protest. But can it have effect on the financial status of a country if a woman passenger coming from Paris happens to be in possession of a bottle of perfume, a passenger from New York a new American fountain pen, or somebody from the Azores a pineapple? If this were really the case, then such a country would simply have no right to exist. On the other hand, if customs officials, police or other supervisory bodies can give no proof of their usefulness other than by subjecting people annoying and ridiculous procedures, then the best we could do would be to do away with them. It cannot be that these officials have no other duty besides stamping papers and burrowing into dirty linen. If this were the case, then the whole thing would be an inglorious waste of time and money. It would be too much to ask that trained psychologists be recruited for such posts, but it would be well within bounds to expect them to be more or less intelligent and reasonably human, in order that travellers' lives should not be complicated unnecessarily, not to speak of the bustling air travellers. The latter do not wish to pay a higher price in order to save time if these precious hours are to be wasted because of slow-thinking customs officials.

We agree entirely with Priestley. The tendency at international airports is indeed to treat the travelling public like sheep. Of course, if the travelling public feels that it is better than sheep, then it jolly well ought to do something about it. In democratic countries, for the time being, it has the right—one might even say the duty—to point out that all these officials are after all public servants.

*

Let us complete the picture by illustrating the "small tragedy of our time" with another example, which approaches the commercial aspect more closely.

The London publishing firm "Views" recently brought out a book called "Cuckoos in the City"; the authors have chosen as pen name "Castor and Pollux." Why cuckoos, you may ask. You will soon see what it is all about.

It is very possible that a fanatic like Sir Stafford Cripps, or certain officials, customs officers and "leaders of state-led economy," will not be any too pleased about this book. If they had nothing more to lead, in other words if everything were going as smoothly as of old, what would become of them? It is probable that they would be made dependent on public charity—which, as a matter of fact, they are indirectly already. Meanwhile, let us have a look at what Messrs. Castor and Pollux have to say.

> "The 'great mistake' was made in 1914, when our gold coinage was withdrawn from circulation, and some 500 million sovereigns—coin of the realm—were buried in Fort Knox. These 500 million sovereigns, at today's price of gold, have a purchasing power of £1,000 million, proving the stability of the gold sovereign even when buried in the ground for years."
>
> "Our merchant-adventurers, who through the centuries have fed and clothed our overflowing population so generously, are fading away with the disappearance of individual freedom to trade, the advent of bad money, the ban on travel, and the totalitarian rule of socialistic economists. ... Today the City is a city full of politicians, economists and Government officials begging dollars of doubtful value from the money-changers' tables of Wall Street. Such a city of sycophants will never feed or clothe our own or any other people."
>
> "Money monopoly in the hands of international financiers is bad enough, but money monopoly in the hands of officials means the end of freedom for life and property. Unless we are free to travel and trade the world over, we must perish."
>
> "What sort of fools are we to swallow the Government's blatant and costly propaganda? Flaming placards and large-lettered advertisements tell us that our wants, shortages, queues and other discomforts are due to inflation. 'Too much money chasing too few goods.'
>
> "Who creates the 'too much money'? The Government. Who chases goods out of the country and refuses to let goods come in? The Government, with their quotas, controls, trade and travel restrictions."
>
> "It is the Government itself, and not the people who create inflation, for inflation is caused by national over-borrowing—not against real assets, but against mere I.O.U.'s."

Where England's gold is buried: Fort Knox, Kentucky, U.S.A.

The Bank of England, "The Old Lady of Threadneedle Street"; on the right is the Royal Exchange.

> "What we do lack at present is an honest pound sterling, worth its weight in gold, as the banking basis of our trading overseas; and we lack freedom to trade... We do not advocate a return to the gold-bullion standard. Far from it. We make a plea for a gold coinage... A gold coinage is rogue-proof, fool-proof and politician-proof."

The none-too-gentle reminders thus formulated by Messrs. Castor and Pollux for the benefit of the leaders of nationalised British economy can without a doubt be applied to such "leaders" in other countries. It looks as though people in our democratic age have become too lazy to think, or just cowards.

*

Let us return to the Brussels Meeting of IATA, where all the big international airline companies were gathered, and we shall have no difficulty in applying usefully these considerations of courageous British economists to civil aviation.

We learned in Brussels that aeronautical engineering has advanced tremendously, and is continuing to progress. Air Commodore Sir Frank Whittle, the British jet engine pioneer, addressed the assembly on the subject of applying gas-turbine engines to civil air transport. According to Sir Frank, airliners powered with propeller-turbines should be ready for civilian use within five years, operating on schedules of 300 to 400 m. p. h.— and these aircraft must be more economical and more reliable than piston-engined types. Once a certain degree of improvement and standardisation is introduced into airport traffic control methods, then, in the opinion of Sir Frank Whittle, a brighter era of aviation will begin. Let us hope his words will be justified.

But what is to happen in the meantime?

As far as we can see, airline passengers on every airport will continue to be searched for bonds, gold bars, narcotics, shoes, perfume, magazines, cigarettes, stockings, and so forth; officials will continue to have the right to cross-examine us, strip us if they feel like it, and in general treat passengers like a flock of sheep.

Every country whose economy is State-controlled — and the majority of countries are highly delighted to be governed in this manner — will either turn down applications for foreign travel, or only authorise them in conjunction with Draconic limitations. In the case of business trips, for instance, these limitations require that the traveller prove that his trip abroad is in the national interest — an extremely elastic term. They also take care that the travelling businessman be authorised to draw on but the barest necessities as regards currency and that the distribution be literally drop by drop. Such a traveller, as a servant of the nation, has no right to make personal acquisitions, to indulge in any pleasure or seek fairly comfortable accommodation. When he is abroad he has to work in the interest of the nation, and if he stays one day longer than foreseen, and his money runs out, then he may be obliged to sleep on a park bench. If it concerns a person travelling for pleasure, however, then it often happens that he only gets permission to go abroad if he can prove that he is suffering from a serious illness — tuberculosis, for instance — and will almost surely die if he is denied the advantages of a foreign clime.

Here you have an excerpt from the sort of State leadership concocted by those officious bureaucratic cliques from which, it would seem, the world has never been able to liberate itself since the adventure of the year 1914.

In this connection it is perhaps appropriate to exercise a certain amount of caution when using the word democracy. The measures which the Governments of democratic countries frequently apply today, differ in this respect only by nuances from the system invented by Messrs. Mussolini and Hitler, and retained by Mr. Stalin. We are being treated like sheep because — to quote Priestley again — we are turning into sheep.

Hitler arranged for his sheep to travel abroad under the motto "Kraft durch Freude." A simply stunning invention, a circus of sorts, an undertaking to bring the nations exceptionally close together! Party members were loaded like sheep on to a troop transport ship, allowed to go on land occasionally, but only under strict supervision and in hermetically sealed groups, and encouraged to sing the "Horst Wessel-Lied" to keep their spirits up. And when they reached home again Goering asked them — to quote the German poet Karl Zuckermayer — the seductive question of whether they preferred butter or cannon. A wily statesman, Goering made the decision for them — in the favour of cannon. And the circus went on.

Perhaps you can tell me how big the difference is between the German trips abroad of Goering's epoch and the British ones under the Crippsian aegis. Personally, I fail to see any essentially great difference.

*

It is therefore not astonishing that such comprehensive State control places world commercial aviation — that proud achievement of our day — in a difficult position and threatens to bring it to a dangerous point of stagnation.

The IATA Director-General pointed out that the route network of the international airlines in 1946 has reached 500,000 miles, and was being flown by a total of over 2,000 air-

Air Commodore Sir Frank Whittle in Brussels. On the right is Mr. Gilbert Périer, President of Sabena and IATA President for 1947-48.

craft, predominantly twin-engined DC-3s or C-47s. According to Sir William, there has been no great increase in these figures during the intervening year; IATA members have merely intensified their services along existing routes by flying larger aircraft and by increasing the number of schedules. Meanwhile, as a natural consequence of State hindrance throughout commerce, the capacity has not been exploited to the same extent as it has been increased, so that the airline companies — with few exceptions — are today working at a loss.

Leaving aside Soviet civil aviation, the IATA member airline companies operating international routes cashed in around one billion dollars during 1947 — which can be interpreted as a lot of money, or very little money. A lot, because it is nothing short of a miracle that people still travel. Little ?

How little this billion signifies is illustrated by Sir William P. Hildred in the following comparison.

The U.S. domestic carriers, which still continue to grab the lion share of world aviation — it so happens that the Yankees are about the only free people left today — shared in the above sum to the tune of $350 million. Meanwhile, however, this income is less than even the net annual profit of General Motors Corporation; the latter's net profit — not merely income, mind you — was $110 million during the second quarter of 1948. Civil aviation, about which so much fuss is made, is a far less productive industry than an automobile and refrigerator industry; its annual receipts are lower than those of the cosmetics and synthetic vitamin industries. The expert is surprised and the layman is truly amazed.

Why ? The explanation is obvious. General Motors Corp. or Elizabeth Arden have a right to work on a private-enterprise basis. Civil aviation, as a public medium of transport and as an auxiliary arm in the event of war, is from A to Z under State guardianship. Of course, no one can deny the State the right to watch over a branch of the public services, which civil aviation is. It gives the taxpayer the right to use it, civil aviation is still a young formation, and international air traffic control requires government supervision. But why there have to be 17,000 employees in the Civil Aeronautics Administration and the Civil Aeronautics Board, thus considerably more than in the State Department, probably remains an enigma to the Americans themselves. And why the British Ministry of Civil Aviation has more employees than the Ministry of Health or the Home Office is probably also too much for the British to understand, especially when they consider the poor progress made in civil air transport.

You see, how it begins with the customs officer, how it continues in foreign ministries, air ministries, and all sorts of governing bodies, and you understand why Sir William P. Hildred — one-time Director-General of British civil aviation, thus having been an official and knowing the field all too well — today expresses his horror of officialdom, travel hindrances and formalities.

You will furthermore understand that all these officials require to be nourished, that they represent a burden, amounting to billions in gold, on the shoulders of world trade and — from a percentage angle — on world civil aviation. And then you read about strikes and revolts against starvation in all corners of the earth.

*

Every day, every hour, we experience anew just how bad conditions are in our glorious technical age. The time will come when flaming placards and large-lettered advertisements displayed by Governments will no longer quell public mistrust. Strikes, revolts against starvation, months of secret palavering in Moscow, UNO meetings in Paris, a Berlin air-lift adventure — all these things are most disquietening to the average citizen.

We seek and put the blame for the bad functioning of world trade, for the hindrances placed in the way of business — in the present instance, for the difficulties in civil aviation — on a number of minor officials. We are quite wrong. It is we who are to blame, since we — everyone of us is a constituent part of what is called public opinion — have elected bad politicians ever since 1918, and thereby have ourselves indulged in bad politics.

We succeeded in effecting the first separation of the East from the West at Versailles. Our politicians occasionally recognised the folly of this, endeavoured to rectify certain wrong clauses, but they never had the courage to look truth in the eye and act accordingly. Thus it came about that politicians condescended to negotiate with the democrats of the Weimar Republic — since then, the latter have either been liquidated or sent into exile as a reward for their uprightness — but in practice nothing was ever accorded them. Later on, Adolf Hitler found himself literally showered with the concessions denied to his predecessors. If only a little support had been given to those of the Weimar Republic, then Hitler would probably have remained true to his original vocation of painting and decorating.

Since 1918, however, Western politics have indeed never missed a chance of stifling world economy, and around 1948 people in the West begin to think that such errors of thirty years back are gradually becoming expensive. In a world at peace — and some of us knew a world of this kind before 1914 — passports, customs examinations, import contingents, travel and currency hindrances, a ban on possessing gold coins — should be incidental or unknown.

If, therefore, we are decided to eliminate these annoyances, then protests, a paper war, or committees, are utterly useless. Only deeds can do the trick. One deed, which would be going to extremes, would be another war. Another deed, which would be the most logical one, would be the earnest fulfillment of democratic desires. But this fulfillment would have to be for all who think and desire to live democratically.

Here is an illustrative and practical example of what we mean. In Germany there are about 60 million people with whom one ought finally to conclude peace, to trade, and allow to share in the advantages of civil aviation — apart from the Berlin air lift, of course. In this way a vacuum would be eliminated, a dangerous gap closed, and a hole perhaps opened in what we platitudinously call the Iron Curtain.

We can imagine that it ought to be possible tomorrow even for a Berliner to buy a Berlin—New York airline ticket. We could imagine that this European would not have to wait weeks in police stations, health offices, consulates and so forth, before visiting a relative or a business friend resident abroad. We could furthermore imagine that a procedure of this sort would necessarily constitute a very bad or a very good example for the inhabitants of Warsaw, Budapest, Bucharest, Belgrade, Moscow, and elsewhere. And what is good enough for one is good enough for another. If an American or a Chinaman feels like flying to Berlin or Moscow, be it for business or for private reasons, the way ought to be open to him. This is the meaning of freedom in commerce, freedom of life and property, human freedom.

If our present politicians are incapable of obtaining this freedom for us, or if they are afraid of such freedom for party reasons, then let us put businessmen in their places. And if these do not manage to do the job, then — but only then — *regis ultima ratio* . . .

Our world really does not deserve a better fate. And it now stands at the crossroads.

*E.E.H.*

Three prominent IATA personalities: *Sir William P. Hildred* (centre), Director-General of the Association; *Mr. Gilbert Périer* (left), President of Sabena and IATA President for the past calendar year; *Dr. Albert Plesman* (right), KLM President and 1948-49 IATA President.

# WAR MEANS... BLOOD, SWEAT AND TEARS

## Wonder Weapons or Transport Aircraft ?

*Robot soldiers*

Thirty years ago, before anybody had started thinking about rocket missiles, atom bombs, bacteriological warfare and the like, and at which time humanity was still weary from World War I, there appeared a small pamphlet on the subject of "warfare without Man." The opposing parties had their differences settled by robot soldiers, who fought the grimmest of battles without shedding a single drop of human blood. The party whose army was first reduced to scrap-iron acknowledged its defeat and accepted the inevitable peace-treaty conditions — which, in view of such humane concepts of war, were not all too severe.

The fact that, following this second world conflagration, hardly any signs of war-weariness are to be observed as regards light reading matter, gives one food for thought. No book on atomic warfare has time to collect cobwebs on the bookseller's shelf ; articles on remote-controlled missiles or biological methods of annihilation invariably find endless numbers of readers.

Should the explanation be sought merely in a gradual return of mankind to barbarism ? Hardly. Of course, there is no denying that two world wars in relatively quick succession, must be to the detriment of a humanitarian way of thinking. But there must be other reasons for this voracious appetite for war literature. Behind people's willingness to be told (by authors of varying degrees of competence) about the technical progress in armament, could be the desire that such progress may entirely rid warfare of human sorrow and suffering, or at least reduce considerably the duration of future hostilities.

As a matter of fact, this desire is not entertained by laymen only. An analogous development is anticipated even by distinguished military authors. General Carl Spaatz, the top U.S. airman up to a few months ago, writes as follows in the September 20th issue of "Newsweek" :

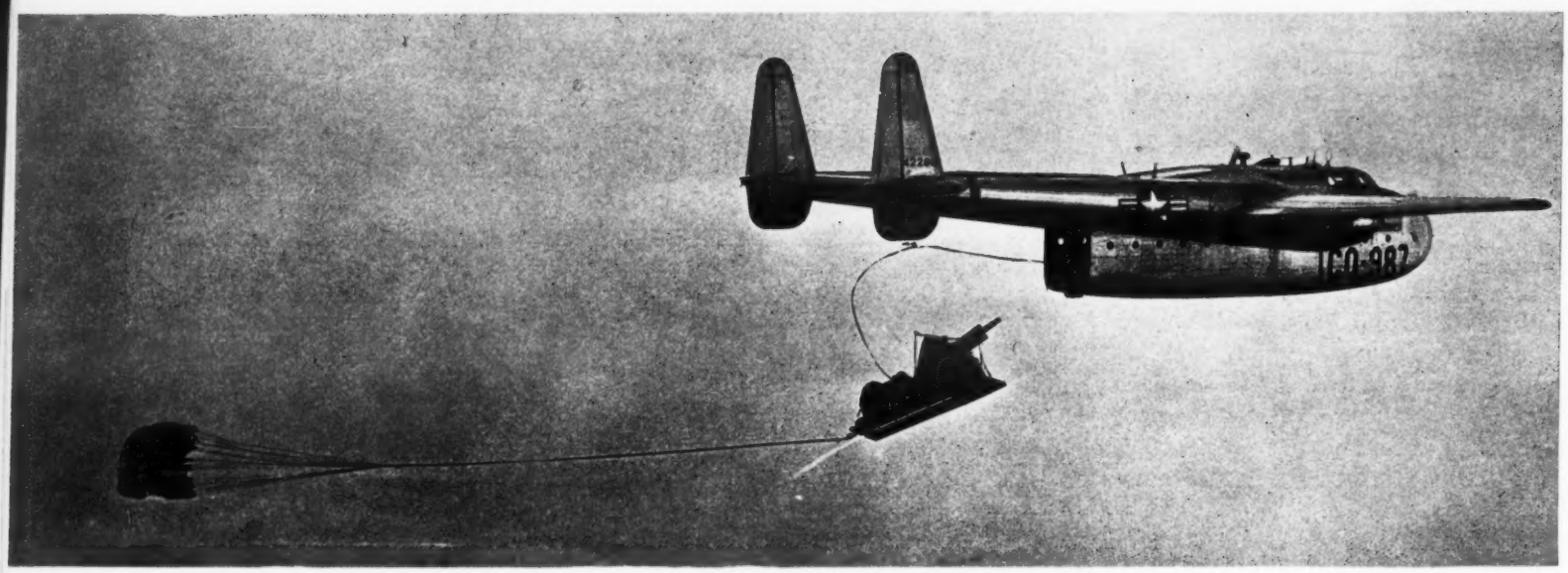
"As our forces grow stronger under the impact of the rearmament programme, we gain insurance, first, that war will not take place at all, or, second, if started, that it will be ended quickly."

If an expert, after sober calculation, tends towards such conclusions, then what must the layman expect from modern weapons, be these already in existence or merely in the dream stage ?

In this connection, it behoves us to recall certain identical prophecies which trace back to earlier generations.

At the time of Napoleon III, all France was convinced that the first machine-gun, just invented by Colonel de Reffye, would end a war automatically and in the twinkling of an

"Soldiers need transport aircraft. . ." A. U.S. airborne unit flies to the jump-off spot in a Fairchild C-82 "Packet."



A 105-mm. pack howitzer is dropped by parachute from a Fairchild C-82 "Packet."

eye. Well, the "canon à balles" is now in the Paris military museum, and since then wars have been bloodier, longer and more sorrowful.

*Rockets alone will do the job . . .*

It is understandable that the most fantastic of hopes are specifically coupled with air power, and that the average man imagines that, in a case of emergency, pressing a button will suffice to send off a few thousand unmanned rocket aircraft loaded with atom bombs, and thus to end a war in a matter of hours. This erroneous idea is nevertheless pardonable, for the reason that the actual development of aerial warfare equipment is proceeding with amazing rapidity and also because it cannot be denied that the strategic concepts of time, space and number have to some extent become outmoded since the creation of air forces. Meanwhile, however pardonable these deceptive conclusions may appear, they are still deceptive... and therefore dangerous.

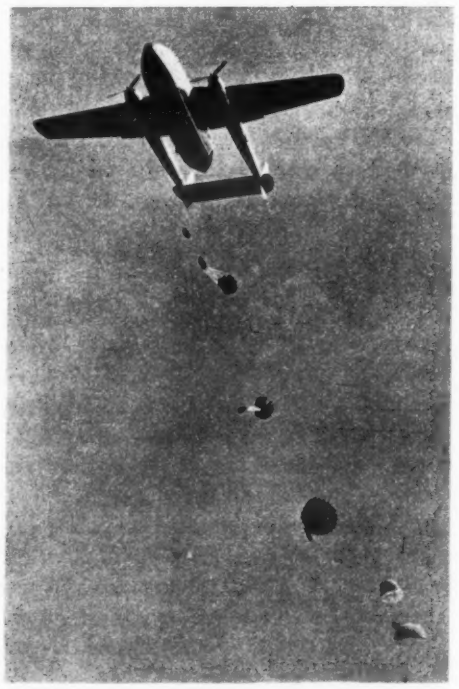
The well-known French military theoretician, Camille Rougeron, discusses modern warfare equipment in his most recent book, "La Prochaine Guerre" (Berger-Levrault, Paris, 1948). In addition to already available arms such as rocket missiles, atom bombs, poison gas, etc., he also examines in detail those which are projected or, at the outmost, under consideration (biological and meteorological warfare). It is significant that, whilst recognising the efficacy of modern arms, he always thinks of possible means of defence and systematically studies them. In his opinion, light armour plating will constitute an adequate protection against the blast of the atom bomb, and this will "nearly always" be sufficient protection against the accompanying heat radiation. It may be more difficult to find something against the radioactive rays, but experiments made hitherto have shown that concrete and tungsten steels form efficient shields ; otherwise, a soldier in a fox-hole is relatively well protected since earth absorbs such radiation. Rougeron continues with the words :

> "There is a shield against every weapon. The atom bomb will be no exception to the rule. Civilians and soldiers will adapt themselves to it, just as they adapted themselves to ordinary bombs and to machine guns. The explosions which blew away only a few metres of the bottom of the Bikini atoll, will have no effect whatever on people sheltering several hundred metres beneath the earth's surface."

It is not so essential whether Rougeron's concepts of defence will or will not suffice in practice, or whether entirely different procedures will be necessarily. Important is that his reasoning is right. Neither is the atom bomb an "absolute weapon" which will dethrone the infantry of its queenly status. On November 12th, 1945, the Commanding General of the U.S. Army Air Force handed to the Secretary of War a report on the bomb damage in enemy countries. From a percentage standpoint, Hiroshima and Nagasaki — the only targets atom-bombed — suffered less

U.S. paratroopers descend over Normandy Field, Alabama.

The equipment "jumps" after the troops. Fourteen packs, each weighing 75 lbs., can be dropped in seven seconds.



devastation than many other cities which were attacked (though repeatedly) with ordinary bombs : Hiroshima, 41.8 %, Nagasaki 35.6 %, Tokyo 39.9 %, Yokohama 57.6 %, Kobe 55.7 %, Heilbronn 82 %, Pforzheim 83 %, Wuerzburg 89 %, Elberfeld 93 %.

Naturally it would be equally foolish to under-estimate the terrible effects of the atom bomb, and it is therefore totally incomprehensible that Major Alexander P. de Seversky (our Editor-in-chief usually says about him : "One argues about his aircraft constructions, and his military writings are not always proved exact"), after visiting Hiroshima and Nagasaki, could write (The Reader's Digest, March, 1946) :

> "The more painstakingly I analyse my observations, the more convinced I am that the same bombs dropped on Pittsburg or Detroit would have exacted no more toll of life than one big block-buster, and the property damaged might have been limited to broken window-glass over a wide area . . . All we can say with certainty is that the atomic bomb proved extremely effective in destroying a highly flimsy and inflammable city."

We would be ill-advised to take sides with this notion. But despite rockets, atom bombs, bacteriological warfare, and so forth, certain strategic concepts remain valid throughout all ages. Certain theories on tactics written over 100 years ago by the Prussian military teacher, General Carl von Clausewitz, may be obsolete and forgotten. However, what he wrote in 1831 on armament in "Vom Kriege," still applies today :

> "The necessities of combat soon incited Man to invent suitable equipment for assuring his superiority over his opponent ; this has brought about great changes in the appearance of the combat, but, whatever form the latter may take, the notion thereof has not changed in any way ; and this notion constitutes war . . . It is clear that armament and equipment are not an essential part of this notion, for mere wrestling is also a form of combat."

Truism ? Perhaps. But it proves conclusively that rocket aircraft alone cannot win a war. In this connection, certain strategic prerequisites are and will continue to be indispensable (Clausewitz's chapter on "Zweck und Mittel im Kriege") :

> "The enemy forces must be destroyed, *i. e.* rendered to such a state that they can no longer continue the fight. The enemy territory must be conquered, as this territory could give birth to new belligerent forces.
>
> "Even when both these conditions have been fulfilled, the war (the belligerent attitude of enemy forces towards one another) cannot be regarded as over as long as the enemy's will has not been broken, *i. e.* its government and subjects have been induced to sign a peace treaty or the nation is willing to be dominated."

If to gain a victory it were sufficient to conquer large areas of territory, then the Japanese would have won World War II in the year 1942, since half the Pacific was in their possession. If superiority of equipment were sufficient, then Leningrad, surrounded and cut-off from supply operations, would have fallen as prey to the stronger German war machine.

We say it again : rocket aircraft, atom bombs, bacteria, and so on, can contribute greatly, but, paradoxical as it may sound to modern ears : only soldiers can decide the outcome of a war — and these soldiers need *transport aircraft*.

*Phantoms or transport aircraft ?*

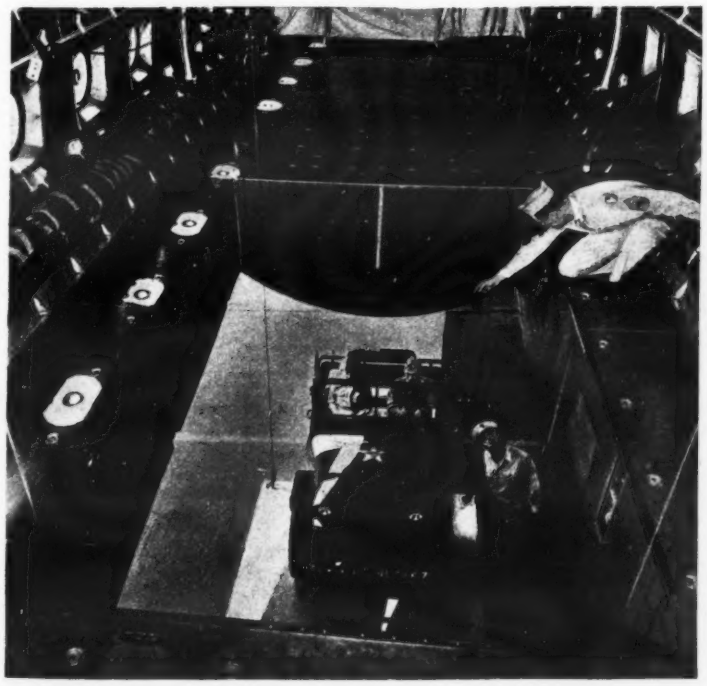
The air force concept is young. Aircraft and aerial war equipment have developed at a meteoric rate — and opinions on their strategic value have changed with equal rapidity. Only twenty years ago the head of the French Ecole de Guerre (Debeney) wrote :

> "Have we got an artillery ministry ?...
> Then for what do we need an air ministry ?"

During World War I we looked upon the air force as a sort of "winged horse guards" unit, a branch for knights in shining armour, demanding lots of courage, brave acts, and occasional reconnaissance missions, but without any apparent strategic value.

There followed the inter-war period, with General Douhet's cries of alarm about air power, high-pressure German arming in the air, excessive publicising of Italian air armament, establishment of parachutist units in Soviet Russia. But the public's attitude did not change appreciably. A few years before the outbreak of the last war, cinema-goers laughed at newsreel shots of Russian paratroopers. Then came the conflict, the destruction of Germany's industrial and trade centres,

An Army jeep being hoisted into a Douglas C-74.



A 105-mm. pack howitzer is rolled out of the aircraft.

the atom-bombing of Nagasaki and Hiroshima.

Today ? People have become "rocket-minded." Public opinion and military writers seem to have gone to the other extreme and tend to attribute to air forces, properties which they simply cannot have. This is unhealthy. A nation which allows itself to be swayed by wonder-weapon concepts, will be defenceless when an emergency arises.

Now, the Americans are a sober-minded nation. They can add two and two, and do not think it a disgrace if their Secretary of Defence was formerly an investment banker.

Recognised as a foremost expert on airborne warfare, Major General James M. Gavin, U.S. Army, in his book on the subject, "Airborne Warfare" (Infantry Journal Press, Washington, 1947), holds no brief for theoreticians who consider armies and navies to be superfluous. Well towards the beginning of his chapter on future airborne armies, he says :

> "To begin with, I am assuming that there will be a definite need for troops to fight upon the ground. Despite the opinions of advocates of victory solely through air power, such as Douhet and De Seversky, I believe that any bombing or guided missile attack will need a human follow-up force to exploit the disorganisation and chaos that future bomb and missile attacks will cause. The fighting that follows may or may not be severe or prolonged, but that there will be need for such fighting in some form does appear to be inevitable."

General Gavin then explains in simple language what he thinks the U.S.A. needs in the way of defence material. He discusses the transportation by air of those divisions which have to take with them everything necessary for establishing an airhead, contacting the enemy, advancing, but also for organising supplies, laying down runways, and so on. He shows why an engineering unit will be one of the most essential components of an airborne division, and how much material must be got together before the first utilisable runway can be built.

It is significant that General Gavin's book does not contain one word pertaining to anything approaching what one might call wonder weapons. True, he speaks of future aircraft designs, advocates transports with detachable fuselages (which have since gone into the development stage), and imagines the use of large rotary-wing aircraft. But his calculations and prognostics are based on existing aircraft or prototypes, mostly military counterparts of the best-known airliners : C-54 ("Skymaster"), C-97 ("Stratocruiser"), C-69 ("Constellation"), C-74 ("Globemaster"), "Constitution," Convair C-99 ; among twin-engined types, Douglas C-47, Curtiss C-46 "Commando" ; and a pure cargo aircraft, Fairchild C-82 "Packet." Already today, his list is no longer entirely up-to-date : the C-74 will give way to the larger C-124A, a C-118 military-transport version of the DC-6 is on the way, and the C-82 "Packet" will be superseded by the C-119 and C-120 (with detachable fuselage). But the very fact that Gavin's list is already partly behind the times is evidence of the author's caution and level-headedness. The domain of fantasy has no snares for him.

Meanwhile, Gavin is not alone with his sober theories based on existent, "conventional" war material. In the house magazines published by aircraft manufacturing firms — as for instance the profusely illustrated paper, "Pegasus," issued by Fairchild's — a search for wonder weapons will be in vain. An admirable epigram to this American realism has been written by W.B. Courtney in an article entitled "Air Transport, the Answer to Air Power" (Collier's, August 28th, 1948) :

> "No air force is stronger or faster than its slowest air logistic plane !"

*

On September 18th, 1947, the U.S. Air Force was separated from the U.S. Army. It thus took its place alongside the Army and Navy as an autonomous branch of the U.S. armed forces. Gone is that epoch when the necessity of an air ministry was a point of argument. But it would be unjust still to look upon an air force as a sort of circus turn, a conjuring trick. Air force service is plain military service. And the air force, now that it has come of age, needs — if it is to flourish — a healthy civil aviation organisation in peacetime, as soil in which to set its roots. W.B. Courtney, in the article mentioned above, makes this very clear :

> "With many manufacturers and airline operators in the red for millions, it is folly to hope that the logistics air fleet our security requires, will grow up, normally and in safe time, from private aviation industry enterprise."

Look at it from any angle you wish. Imagine a country which is a sea power, letting its merchant shipping go to seed. Not only would it drive a number of shipping companies to bankruptcy, but it would lose everything that goes with power on the sea, thus its entire status as a sea power.

Wars cannot be fought without soldiers, naval battles cannot be decided without sailors ; and if one allows civil aviation and all that goes with it, to go to waste, the most ingenious of wonder weapons will be failures.

*Hd.*

# Fly-Weight

Can you beat it ? A complete personal aircraft, with propeller, wings and a proper undercarriage — all weighing no more than the pilot !

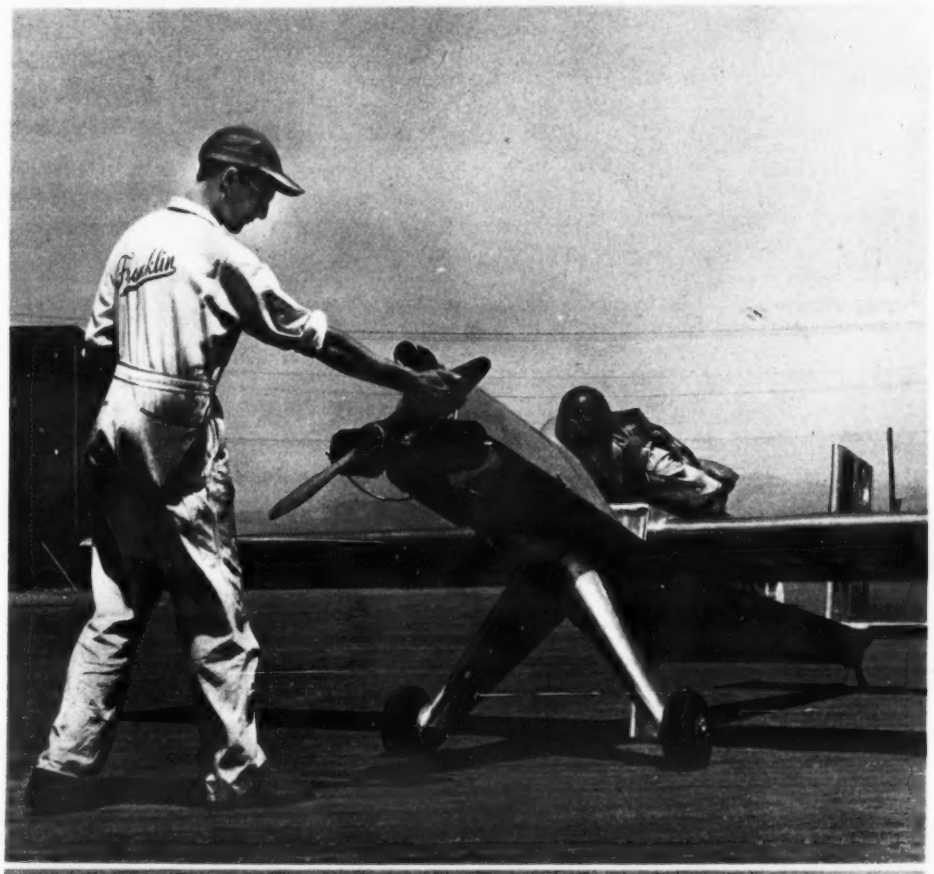
The world has always had crazy inventors. The most amazing contraptions have been born in small workshops, kitchens, cellars, back yards and old sheds Aeronautics, too, has had its crop of inventors — who, with varying degrees of success and professional knowledge, but with unlimited reserves of optimism and self-confidence, have striven to assemble flying machines. Many readers will surely recall the French "Pou du Ciel" and its derivations, which for some time populated all small airfields . . . and occasionally the sky, too, until sufficient young people had lost their money, limbs or lives, and the entire nonsense was finally banned.

Risks that can be taken with land vehicles or boats without very much danger, can have disastrous consequences when it comes to aircraft. Even the most unairworthy-looking devices can, contrary to all expectations, nevertheless start rising above the ground. Besides bitterly disappointing the inventors, such experiments are unfortunately often the beginning of tedious negotiations with accident and life insurance companies.

The invention which we are presenting here for the delight of our readers, originates from America. The man responsible for it, Mr. Ken Coward, of San Diego, is photographed in full dress. Don't run away with the idea that he is looking for a penny which has dropped to the bottom of the cockpit. On the contrary, he is ready to take off, and is showing the amazed onlookers just how far Man's ingenuity can extend. Lying prone on the fuselage of his "Weebee" — no etymological trap here — Coward intends to travel through the air (don't ask us to call this mode of locomotion "flying"). For centuries, savants have taken pains to prove that one of the main characteristics of *homo sapiens* is his erect way of walking. And now a Mr. Ken Coward springs up in San Diego and disproves the whole theory. His arms extend into the dark interior of the "Weebee" and fiddle around with the ailerons, elevator and throttle lever, whilst his head chiefly strains his neck muscles. With his feet he supports himself — let's hope he continues to do so in flight — on the rudder.

Evidently, Mr. Coward is bent on living down his name. His intention is not merely to be photographed, but really to fly . . . in the "Weebee." Incidentally, he has worked out exactly that his aircraft, which weighs 160 lbs. empty and 380 lbs. loaded, and has an 18½-H.P. Menasco engine, will feature a top speed of 90 m.p.h. and cruise at 83 m.p.h.

By the time these words are in print, Coward will probably have manoeuvred his "Weebee" successfully through the air. We are keeping our fingers crossed, wish him happy (and soft) landings and — if we may say so — good natural upholstery !



# "It works!"

## Rough Indoctrination in a TF-80C

BY SCHOLER BANGS, LOS ANGELES

It is not the most pleasant of sensations to be just off the runway in a jet fighter and suddenly realise that the hydraulic boost on all your controls has failed.

Especially if it is one's first flight in a really "hot" aircraft, Lockheed's famed "Shooting Star."

It is apt to induce those long, long moments of varying regret.

JET JEKYLL-HYDE: Studio portrait of author shows a pleasant young man, who is transformed into...

... this horrid monster when "made up" for 600-m.p.h. flight in Lockheed's two-place TF-80C "Shooting Star." Bulging crash helmet strapped to press earphones tightly in place and upper-lip microphone produce an effect which might have delighted Robert Louis Stevenson.

But with it, in my case, there was a deeply breathed "Thank you!" to whoever within Lockheed dreamed up the idea of stretching out a P-80 and placing directly in front of me, to do the flying, one of the company's top test pilots.

At the invitation of the U. S. Air Force and Lockheed, I was being given a courtesy indoctrination, and rather rough, in the very latest of the "Shooting Star" family, the 600-m.p.h. two-seat dual-control TF-80C trainer-fighter.

In a way, I had asked for it.

Herman R. "Fish" Salmon, my pilot, had wanted to know, as we sat tightening the Sutton straps over our shoulders, if I wanted the "grandmaw ride" or "the works."

"The works," I said, and with a hydraulic hiss the big bubble canopy came down, and I could hear the gentle muffled thud of eight steel latches gripping the canopy against the 18,000-pound aerodynamic pull which could be exerted upon it at top speed.

"Blam!"

The "works" started early!

Jolted by a false-start explosion of scavenged fuel in the tail-pipe area, the plane shook as if rammed by a truck.

Off ignition—a quick stripping of inspection plates to look for possible damage—and try again; a smooth start this time, with the turbine whine rising as we moved away from the ramp. It conjured up alluring advantages of jet airliners... just turn on the power and glide away from the ramp; and once at the end of the runway, no exasperating engine run-up... no waiting, sweltering, for incoming traffic which might have been avoided.

Just swing on to the runway, and feel the steady, mounting push of jet thrust against your back as you listen, the jet roar far behind you, for the break in the thumpety-thumpety-thump of wheels on runway to tell you you're airborne.

A boundary wall of eucalyptus had blurred by when I noticed the control column waving widely from side to side and felt our wings weaving sluggishly.

Through my earphones came Salmon's electrifying words:

"Hydraulic boost on ailerons is gone!"

Just 500 feet below us, flitted orange groves and homes of movie stars; no open space for a let-down.

"All hydraulics are out!"

Directly ahead was the 2,000-foot crest of the Hollywood Mountains.

That meant...

You had to have hydraulic boost on the controls to fly one of these beasts...

Or did you?

Airspeed 200. Altitude 1,000... and rising.

Fear? No! A split second of panic, and then cool interest in what was happening.

Some years ago a French air officer (his name

COCKPIT CHECK: Pilot Salmon carefully gives author pre-flight instructions. Central column lowers canopy or, in emergency, tears it free under blast of powder charge.

**STAR OF STORY** is this sleek new two-place dual-control member of the "Shooting Star" family, now in production by Lockheed Aircraft Corp. for the U.S. Air Force.

was Chemedlin, I recall) who had survived a thousand-foot spin cum crash in a twin-engined Douglas bomber being demonstrated for him at Los Angeles Airport, had told his doctor of those fleeting seconds : "When the aircraft went over I knew it was the death. I thought of my wife, my loved ones, in Paris. I prepared myself with God. And then I waited, waited, waited. Why was it taking so long ?"

I have never had such reactions. I had none now. Just a faint, passing regret that, after the tail-pipe explosion, we had not called it quits for the day to permit a detailed inspection and test flight—with the rear seat empty.

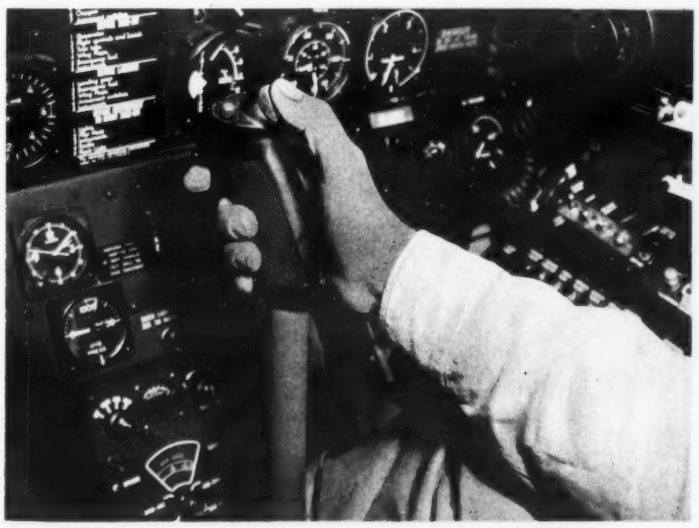
Then I found myself speculating whether we would clear the ridge rushing towards us ; whether we might be able to recover if a thermal bumped us up on one wing.

Salmon's voice again ; and blessed reassurance !

"We still have control—it just takes a little more stick travel and force. Here, you try it."

At least, it was something to do. And would he be having me take over the controls—that

**REAR SEAT** : TF-80C student cockpit duplicates all jet fighter instruments and controls. Plastic button on top of control column moves in four directions by thumb and actuates electric circuits to trim ailerons and elevator. Trigger is for guns or cameras, small button for bomb-rocket release.



**THE COMBINED AIRSPEED INDICATOR AND MACH-METER**, one of the most important instruments on the TF-80C. Large needle near "600" is Mach indicator ; pre-set for Mach .8, top permissible speed of TF-80C, it moves down under influence of temperature and altitude changes. When airspeed needle, moving clockwise, coincides with Mach needle, the plane is flying at Mach .8. In the bottom left corner is the accelerometer ; on the right of the dashboard can be seen the JATO switch.

was the ridge crest which just whipped by below our wings—if we were about to pile up ?

Confidence came in like a raging flood.

And so did our hydraulic system !

A cockpit-wide heave of the stick to get one wing down now required only a nudge, little more than finger-tip pressure ; actually one-fifteenth the force required without boost.

Life was good again, the plane a sweetheart, the sky blue, the August sun bright and hot, and, within our seven-foot-long canopied cell, the mid-summer snowstorm was cool delight.

It came from the floor and "fell" upward ; swirling, scampering clouds of flakes—the moisture torn out of the air, frozen, and then blown into the cockpit by the howling little air-conditioning blower installed to intercept and chill the hot ram air ducted in at high speeds.

The pleasing comfortable "whisper" of the slipstream fingering canopy and fuselage was vanishing and giving way to a rising, wild howling all about us.

Airspeed 450. Altitude 2,500.

Sudden, jolting, jarring bumps accompanied our cruise over the small mountain range separating Hollywood and San Fernando Valley.

All was well with the plane. Its contribution to "the works" was ended ; the rest would be up to the voice which said, "We'll go on up to ten thousand, now."

It felt as if the seat had given me a single, hard spank ; and then I sat watching the altimeter needle in amazement. It was spinning like the dial on a grocer's scale.

I tried to count its rotations... one thousand and one, one thousand and...

Less than two seconds !

How many times around for each thousand feet ?

It was a standard gauge.

I, a thousand-feet-per-minute flyer, found it difficult to realise we were climbing at the rate of six hundred feet per SECOND.

Of course, it was strictly a zoom climb, a vertical translation of our initial 450 m. p. h., but bewilderingly hard to believe. Yet, there we were, eight thousand feet higher in a little over ten seconds.

Airspeed 200 ... just loafing. Altitude 10,000.

Rolls, smooth as glass. Back up to 550 m. p. h. and then, above the howl of the slipstream, a deep, loud roar. Salmon had tripped the dive flaps. I could feel the strain on my shoulder harness from deceleration as the airspeed dropped at the rate of 50 m. p. h. in the first ten seconds. Flaps up and nose down, we glided, throttle back.

Salmon's voice explained the glide performance—175 m. p. h. was best, producing a 15-to-1 glide ratio.

Nose down, a shallow power dive took us to 7,000 feet in a matter of seconds, and as we levelled off, the Mach needle and airspeed hand touched at an indicated 550. Temperature and altitude corrections gave a true airspeed of 600 m. p. h. and a Mach of .8, for which the TF-80C is red-lined. We were flying just under the plane's shock wave zone.

One more "indoctrination" item :

Salmon cocked the plane into a steep bank, pulled back on the stick, and then released it. A mighty, grinding tug pulled at my insides ; my left hand, raised to adjust the lip microphone, hit my lap as if it were made of lead. By the time I could focus my eyes on to the accelerometer, it read "7.5."

That brief moment, not more than a couple of seconds, of 7.5 g was, for me, "the works"—and I want no more of it without a "g" suit.

Never, after those few concluding minutes

**DIVE FLAPS** are a major feature of the "Shooting Star" and can be operated at very high speed. At top flying speed, they slow down plane at rate of 50 m.p.h. each 10 seconds. They are used to reduce speed if pilot exceeds critical Mach reading ; to slow down and keep on target in overtaking an "enemy" ; to allow for a steeper angle of glide.

**DIVE-FLAP TRIGGER** is on the throttle lever. When pilot squeezes this trigger, the dive flaps extend fully in two seconds.

BACK TO NORMAL: Finale to realistic jet hop and prelude to dreamy jet transportation. Danny Bangs has accomplished an important mission and handed back to his author-father (right) the now worthless $25,000 Lloyd's insurance policy. Tomorrow he will proudly tell his school chums an exciting tale about sonic speed, Mach numbers and power dives.

of twisting and squirming at ten thousand, and giving a wayward Navy F-8-F a tactical buzz, had I experienced flight so smooth, and quiet, and seemingly slow as when we glided in for our landing, and touched the runway at a shade above the plane's 112 m.p.h. stalling speed.

The noise at high speed had been annoying, and had made our back-and-forth conversation difficult.

Apologetic, Salmon explained that we had been flying without cockpit pressure and with ventilation systems open and the refrigeration blower working at a noisy high speed.

He said: "At altitude you would have found the TF-80 very quiet; probably the quietest plane you've ever flown in. The cabin would have been pressurised, and only moderate use would have been made of the ventilation blower."

Basically, the TF-80C is an F-80C, and performs with every bit of the speed and manoeuvrability of the single-seater fighter.

What Lockheed has done has been to lengthen the fuselage by 10 inches at the rear junction of the wing fillet, and fashion a fuselage insert of 26 5/8 inches just ahead of and behind the leading edge of the wing, to accommodate the student's seat.

It will be used primarily for direct and rapid training of jet fighter pilots by eliminating the period of transition training in high-speed propeller aircraft, such as the P-51.

For example, the initial delivery of four TF-80Cs to the Air Force will enable a class of 15 cadets, who will have just completed basic training, to commence their jet fighter instruction in mid-October and graduate in February. By the transitional training method, their graduation as jet fighter pilots would require from several weeks to several months additional instruction.

• Tactically, the plane offers even more than its design as a trainer. Its usefulness is already being studied for long-range escort missions, by addition of a 200-gallon fuel tank in the rear cockpit; thus for bombing and strafing, rocket launching, photo-reconnaissance, control and observation of guided missiles, and service as a navigation lead aircraft.

True, it is not the fastest jet fighter now in production in the U. S. A., but there can be little contradiction of saying that it is the most thoroughly proved.

The basic P-80 configuration, improved through its alphabetical series, seems now to have no fundamentally bad habits, and its idiosyncrasies are well established.

These things doubtlessly account for U. S. Air Force dependence today upon the F-80 as its principal jet fighter, pending full production of faster and later designs; and it is conceivable that once the trainer-fighter model is in delivery, quantities will be ordered beyond the 150 initially contracted.

There is one aspect of the "Shooting Star" series which is intriguing, and rightfully should be of some concern to Lockheed's competitors.

What Lockheed has learned from its "Shooting Stars" in the way of jet aircraft structures, high-speed aerodynamics and safety, should add up to an impressive quantity of "know-how" that might be applied to an impressive 550-m.p.h. jet transport.

Salmon agrees to this, and feels that when and if Lockheed takes the next step—probably a military jet transport to begin with—it will contain a vast amount of the experience gained since the original designing of the XP-80 in 1943.

At the very least, the experience of riding as a passenger in substantial comfort at 600 m. p. h. was enough to sharpen an appetite for doing the same thing in a commercial jet transport, and cutting a twelve-hour flight from Los Angeles to New York to five hours or less.

Those were my ideas, mixed with conversation with Salmon, as we taxied back to the starting ramp.

It was a relief to rid myself of the gear of military flight—retaining harness, parachute, microphone, and bulky crash helmet—and to claim from my son Danny, who had accompanied me to the field, the now useless letter John Tower, Lockheed's publicity director, had signed and given me just before I went up—stating that the company was holding for me a $25,000 Lloyd's insurance policy covering the flight.

# Northrop XF-89

John K. Northrop, President of the Californian aircraft firm named after him, is one of those designers who has a marked preference for attacking problems which are somewhat out of the ordinary. Apart from a relatively recent aircraft, the three-engined Northrop "Pioneer" designed for operating in remote and primitive regions, he had so far never built a commercial transport. However, his fundamental theories — for years Northrop has been one of the most stubborn and also most successful champions of the all-wing design — will not fail to influence commercial aircraft of the future.

Up to today, therefore, Northrop Aircraft Inc. has had only one customer : the State. Under contract to the latter, the firm developed the famed twin-engined P-61 "Black Widow" night fighter, of which some 700 units were built towards the end of the war ; this was followed closely by the two "Flying Wing" bombers, the B-35 and B-49, the latter being powered with eight turbo-jet power plants.

Around the middle of last September, Northrop unveiled his newest XF-89 experimental type to the public. As can be deduced from the designation, this is the prototype of a fighter. Equipped with two turbo-jets (make not specified), which lie side by side

in the under part of the fuselage, the XF-89 is remarkable for a spacious fuselage, through which runs an extremely thin, mid-set wing. In order to avoid the zone of disturbance created by the exhaust gases and airflow over the wing, the horizontal stabiliser is located approximately half-way up the vertical stabiliser. The twin nose-wheel is of noticeably small diameter and the main wheels, in view of the thin aerofoil, are exceptionally narrow. Performance data are not yet available and even the dimensions are given only in approximation : span and length are about 50 feet, height 15 feet, and gross weight approximately 30,000 lbs.

Though the XF-89, judged externally, does not give the impression of being a revolutionary new aircraft, the purpose for which it is designed is nevertheless interesting. Manned by a pilot and a radar observer, it is designed primarily as a high-speed, all-weather jet fighter. Judging from the exterior, its maximum speed will probably not be far below sonic velocity ; its equipment, which is naturally a closely-guarded secret, is likely to include the latest in radar-navigation and television material.

It does not seem excluded that the XF-89 may represent the first of a whole series of two-seater jet fighters, since the all-weather operation of high-speed aircraft should, even if the most modern navigational methods are used, require an alleviation of the pilot.

Panair do Brasil's administration building at Santos Dumont airport, Rio de Janeiro.

# Rio de Janeiro — Zurich

by Panair do Brasil

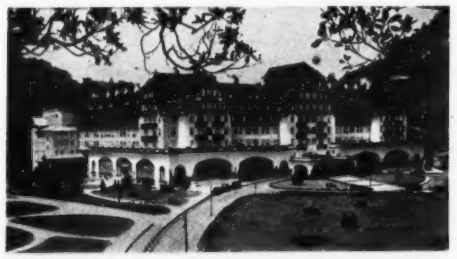
Panair do Brasil yesterday inaugurated a Rio de Janeiro—Recife—Dakar—Lisbon—Zurich (Kloten) air service, the press announced on September 7th, 1948. According to the President of the Company, Dr. Paulo Sampaio, the new route is to be flown once every two weeks, and later weekly, with Lockheed "Constellations."

Just another of the innumerable air route inaugurations of which we read nearly every day. It is hardly worth talking about it... Nevertheless — to use a hackneyed cliché — how time flies. It is hardly fifteen years ago that the Lindbergh couple accomplished their historical flight from Bathurst to Natal. Their aircraft, a Lockheed "Sirius" fitted with floats, was subsequently set up in New York's Museum of Natural History. And the first crossing by air of the South Atlantic, by the Portuguese aviator, Cabral, in 1922, involved six intermediate landings and ten weeks.

*

Nowadays ? Apart from Panair do Brasil, we note that British South American Airways, KLM Royal Dutch Airlines, Air France, Scandinavian Airlines System, the Argentine FAMA, the Spanish Iberia, and other U.S. and European scheduled airline companies come to port in Recife de Pernambuco or Natal, Brazil's principal Atlantic airports. A glance at the map immediately reveals Brazil's key position in civil air transport. Geographically, she rules over the shortest sea road between South America and Africa (1,900 miles) ; only 3,400 miles separate the most eastern tip of Brazil from Lisbon.

The President of Panair do Brasil, Dr. Paulo de Olivera Sampaio (second from left), receives one of his Lockheed "Constellations."



Quitandinha Hotel, in the mountains above Rio, where Dr. Paulo Sampaio presided over the Third Annual Meeting of the International Air Transport Association in 1947. Dr. Sampaio was IATA President for 1947-48.

Brazil's capital, Rio de Janeiro, seen from the air.

*

The need for a Brazilian inland airline network is obvious. Measuring 3,285,320 square miles, Brazil is nearly as large as Europe (3,750,000 square miles). Large regions of the country cannot be approached by surface transport means : the natives of the vast primeval forest districts in the north and the west (Amazonas and Mato Grosso) haven't the faintest idea that they are Brazilians, or of what Brazil consists. Brazil offered great opportunities to civil aviation, and the nation was quick to adopt the aircraft as a means of transportation. Two nations helped notably to establish Brazil's airline organisation : the U.S.A. and Germany.

*

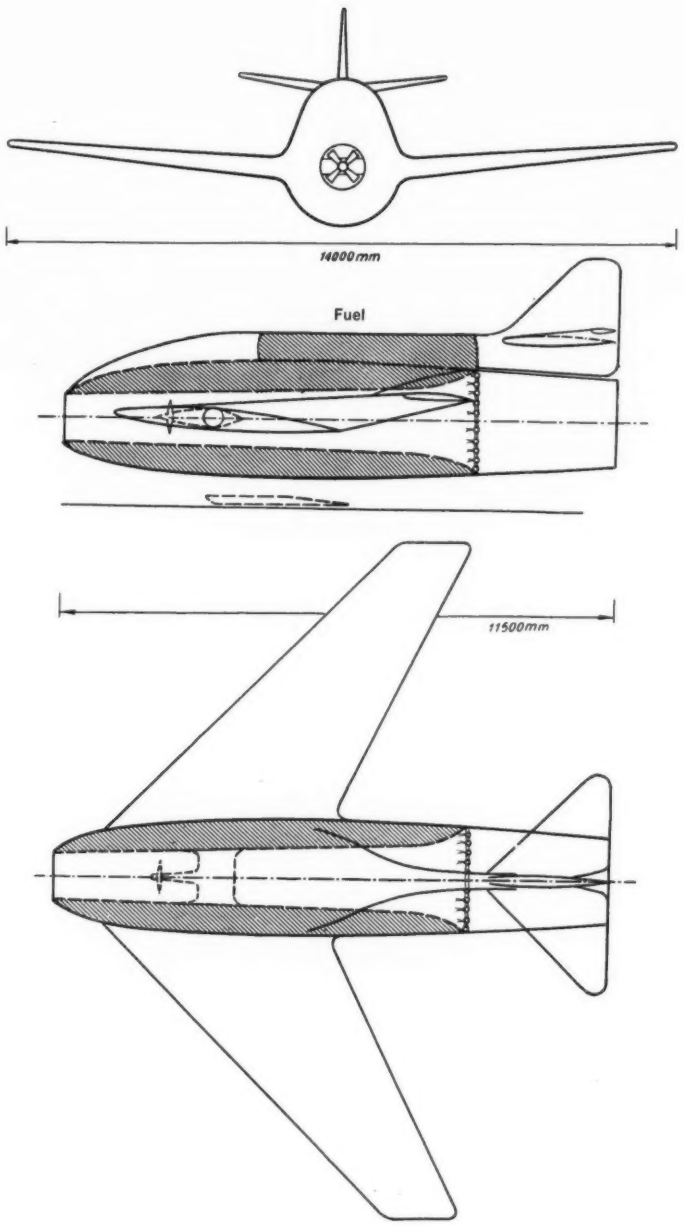
Panair do Brasil was founded in 1930 as a subsidiary of Pan American Airways. For many years it was owned practically alone by the big U.S. company, until in 1947, the share majority passed into Brazilian hands. Still today, P.A.A. is keenly interested in Panair's development. The organisations of both companies work hand in hand, and it is rumoured that the new Panair route to Switzerland is not without interest to P.A.A. ; for the latter airline has not been able to obtain authorisation from the U.S. Civil Aeronautics Board to fly to Switzerland.

Financially too, Panair seems to be following in the footsteps of its U.S. precursor. It is one of the few international airline companies which reported a considerable profit for the 1947 calendar year.

# The Prospects of Jet Reaction Flight

By Dr. Eugene SAENGER, Paris.

*(Conclusion *)*




Estimated aircraft polars for v/a = 0.9 (tear-drop profile)

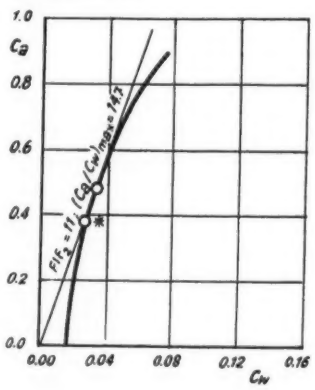



*Fig. 31: Long-range subsonic ram-jet aircraft.*

* Optimum point of application

| | |
|---|---|
| Empty weight | 4,000 kgs. |
| Fuel | 16,000 kgs. |
| Initial gross weight | 20,000 kgs. |
| Cruising speed | 955 km/hr. |
| Length of flight | 9,250 kms. |
| Flight altitude | 11-20 kms. |
| Take-off speed | 360 km/hr. |
| Landing speed | 160 km/hr. |
| Engine efficiency | 8% |
| Specific fuel consumption | 0.74 kg/sec.t. |
| Initial wing loading | 500 kg/sq.m. |
| Wing loading at landing | 100 kg/sq.m. |
| Combustion temperature | 900 deg.K. |

4. *Subsonic Ram-Jet Aircraft.* The relatively low efficiency of ram-jet engines in the subsonic domain indicates atomic heating for subsonic ram-jet aircraft if the latter have to be used for transport purposes over very long distances, or, if chemical heating is foreseen, that they be used for special purposes, for which medium flight duration and range suffice—*e.g.* for military or scientific missions. In the case of fighters, where the ram-jet couples the high climbing speed of the rocket fighter with the flight duration of the jet fighter, the low constructional cost and the possibility of utilising cruder types of fuel speak in favour of the ram-jet.

A subsonic aircraft powered with a pure ram-jet engine is presented schematically in Fig. 31.

The duct, of 2,400 mm. maximum diameter and 11,500 mm. total length, has an external diffuser and a fixed, non-adjustable efflux cross-section $F_4$, and forms the fuselage of the aircraft.

The upper part carries a cockpit, cabins for the crew, fuel tanks, a hold for the useful load, and a tail assembly with rudder and elevators. The mid-set wing passes through the free space of the diffuser.

The landing skid retracts into the thick part of the external diffuser, and the take-off can be effected by releasing the aircraft from a large carrier aircraft at altitude, by catapulting it, or with the aid of a jettisonable undercarriage.

The doubled-walled monocoque construction of the diffuser forms the backbone of the aircraft and allows for the assembly of all the component parts mentioned above. The diffuser also contains the essential elements of the power plant: the injection grill, the fuel supply system, the armatures or, as the case may be, the combustion grill for coal or the lattice for atomic heating.

On the other hand, the combustion chamber and the flame tube, in view of their high working temperature, are located at a distance from the rest of the aircraft and merely consist of a simple steel coque which, because of its rapid detrition by the burners in the zone of the injection grill, can be dismantled and replaced.

A special mechanism for regulating the cross-section would be superfluous in view of the automatic regulating action of the external diffuser which, with $x/l = 0.7$, can be used for Mach numbers approaching 0.9. Owing to the pronounced sweep-back of the wing, the polar divergence of the airframe does not become noticeable until this Mach number has been exceeded.

The aircraft weighs 4,000 kgs. empty, has an initial gross weight of 20,000 kgs., and none of its essential parts move. The aircraft represents a pure sheet-metal structure, if one makes exception of the few auxiliary devices for fuel injection, cabin ventilation, landing-skid retraction and flap adjustment, etc.

The take-off can be effected with the aid of ordinary assisting rockets attached on either side of the fuselage.

* Cf. "Interavia, Review of World Aviation," Vol. III, No. 9, pp. 449-506, and No. 10, pp. 557-565.

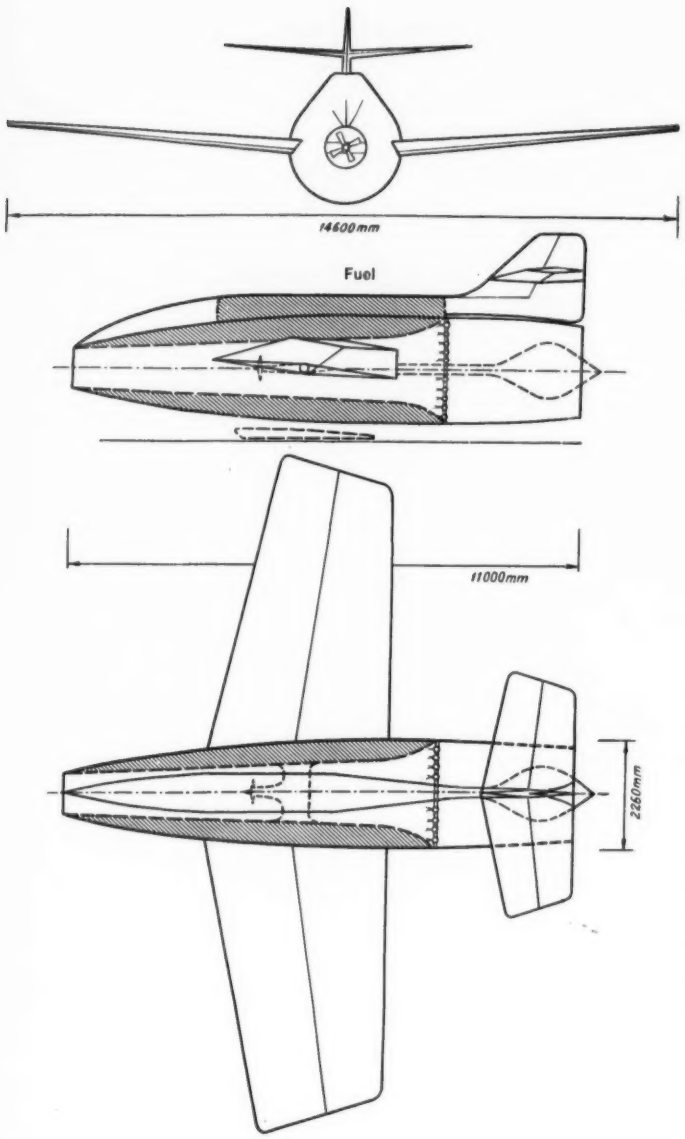
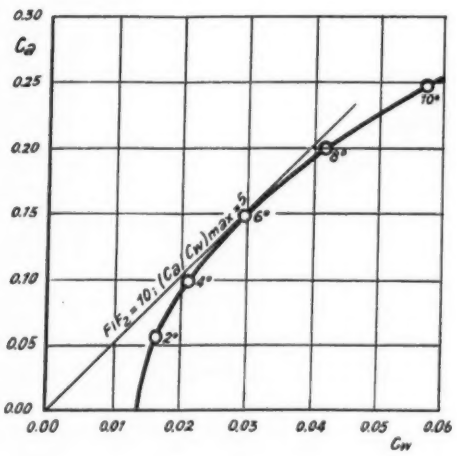



*Fig. 32: Long-range supersonic ram-jet aircraft.*

| | |
|---|---|
| Empty weight | 4,000 kgs. |
| Fuel | 16,000 kgs. |
| Initial gross weight | 20,000 kgs. |
| Cruising speed | 3,200 km/hr. |
| Length of flight | ≈ 10,000 km/hr. |
| Flight altitude | 20-35 kms. |
| Take-off speed | 360 km/hr. |
| Landing speed | 160 kms. |
| Engine efficiency | 28% |
| Specific fuel consumption | 0.7 kg/sec.t. |
| Initial wing loading | 500 kg/sq.m. |
| Wing loading at landing | 100 kg/sq.m. |
| Combustion temperature | 2,800 deg.K. |

Estimated aircraft polars for v/a = 3 (rhombic profile)




5. *Supersonic Ram-Jet Aircraft.* A sketch of an experimental supersonic aircraft powered with a ram-jet engine is shown in Fig. 32.

The speed range should extend up to Mach 3 ; the basic configuration corresponds to the subsonic aircraft mentioned earlier.

The demands as regards flow at supersonic speeds are satisfied by the choice of a pure internal diffuser for the engine, the thin, rhombic aerofoil section of the wing and tail surfaces, the far rearward position of the main frontal area of the entire aircraft, and the regulation of the efflux cross-section by means of an exhaust cone. Because of the high engine efficiency, the maximum range will be great when oil heating is applied, although one must expect the airframe to have an unfavourable lift-drag ratio at a speed of Mach 3.

6. *Long-Range Rocket Aircraft.* Fig. 33 shows the external aspects of an ultra-high-speed supersonic rocket aircraft, taking into account the demands of gas dynamics at high Mach numbers.

The fuselage nose takes the form of an extremely slender ogive cut along its longitudinal axis in such a way that a plane surface forms the underside of the fuselage. At the level of the wing, the semi-ogive transforms progressively into a spacious box of rectangular section, and towards the rear it tapers at approximately the same rate as the central cross-section of the fuselage. The large dimensions of the rear wall terminating the fuselage are dictated by those of the efflux cross-section of the rocket engine.

The relatively small stub wings are mainly for stabilisation purposes during flight and landing ; their aerofoil section is the well-known triangular wedge-type profile, of which the maximum thickness of 1/20 of the chord is located at 2/3 of the chord. There is no necessity for an angle of incidence between the wing and fuselage, with the result that, in view of the low-wing arrangement chosen, the supporting surfaces of the fuselage and wing continue into each other without disturbance. The configuration of the tail assembly is independent of the airstream created in the ambient medium by the rocket efflux, since the rocket engine will never have to function at subsonic speeds.

It is foreseen that the take-off weight should be 100 tonnes and the empty weight 10 tonnes. The dimensions of the wing are determined by the fact that, during catapult launches, at Mach 1.5, approximately 38 per cent. of the weight is made dependent on the supporting properties of the fuselage and 62 per cent. on the wing ; the participation of the fuselage increases very sharply at high Mach numbers, and can attain 66 per cent., later to fall to about 40 per cent. during landings at subsonic speed.

The configuration, at present seemingly odd, of such aircraft designed in accordance with the laws of supersonic flow, is justified by the fact that long-distance flight will be pure motorless flight, using only the kinetic energy ; indeed, a rocket aircraft with a lift/drag ratio of 6.4 already utilises 99 per cent. of its kinetic energy whilst passing from Mach 30 to Mach 3, thus within the speed range of Newton, and only 1 per cent. at lower Mach numbers, at which other aircraft configurations will lead to more favourable values of lift/drag ratio.

## E. *Flight Performance*

1. *Thrust versus Mach Number.* The flight performance depends chiefly on the variations in engine or propeller thrust, versus the flying speed—a function which is presented for a number of large engines in Fig. 35. Noticeable are : *a)* The high static thrust of propeller power plants ; the thrust diminishes rapidly as the flying speed augments and, within a wide speed range, this thrust is inversely proportional to the flying speed and proportional to the output (constant) of the engine ; in other words, $P = L/v$. *b)* The thrust of turbo-jets and rocket engines is constant ; it will also be noticed

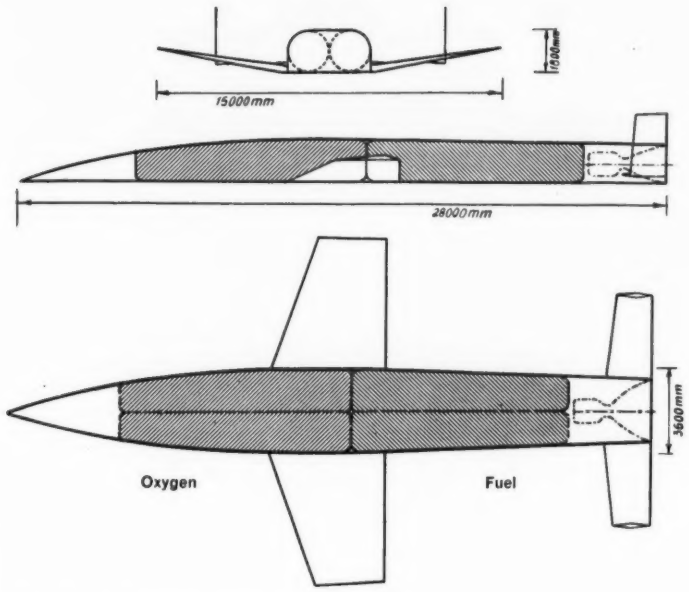
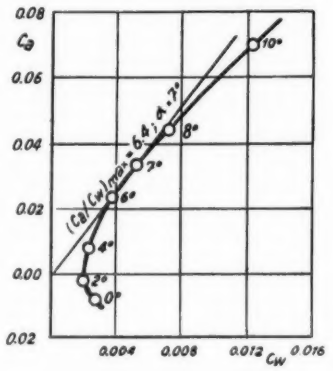



*Fig. 33: Long-range rocket aircraft.*

**Estimated aircraft polars for v/a = 30 (triangular profile)**

| | |
|---|---|
| Empty weight | 10,000 kgs. |
| Fuel | 90,000 kgs. |
| Initial gross weight | 100,000 kgs. |
| Maximum flying speed | 22,000 km/hr. |
| Length of flight | ~ 20,000 kms. |
| Maximum flight altitude | ~ 150 kms. |
| Catapult velocity | 1,550 km/hr. |
| Landing speed | 150 km/hr. |
| Specific fuel consumption | 3.3 kg/sec.t. |
| Initial wing loading | 800 kg/sq.m |
| Wing loading at landing | 80 kg/sq.m. |
| Combustion temperature | 3,700 deg.K. |



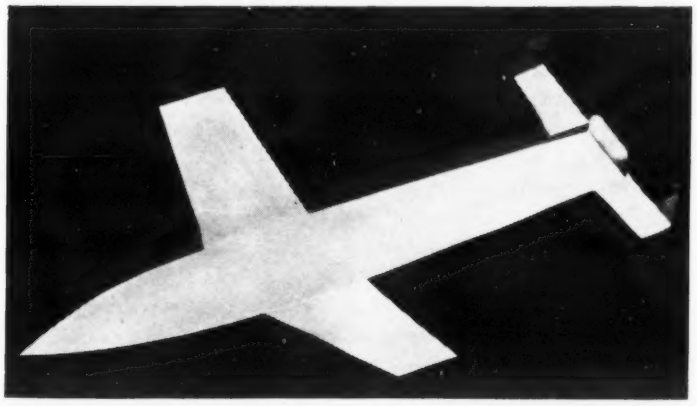



*Fig. 34: Model of long-range supersonic rocket aircraft of 10 tonnes empty weight, described in Fig. 33. Note the completely flat underside, advantageous for very high supersonic speeds.*

that the thrust of rocket engines does not depend on the altitude. *c)* The ram-jet engine has no static thrust, and its thrust increases initially as the square of the flying speed, then more slowly, ultimately to reach a very high maximum ; it will also be noticed that the resonance duct has a very feeble thrust.

2. *Application Points on the Polar Curves.* It is known that, in the case of propeller aircraft, one obtains maximum values of range and flight duration when the point of application coincides with the point $(c_w/c_a)_{min}$ of the aircraft polars, thus at the optimum lift/drag ratio. Similar conclusions can be reached for rocket aircraft.

As long as the polars are independent of the speed, one obtains, in steady horizontal flight for example, the minimum consumption of fuel per kg. gross weight and metre distance or second flight duration, under the conditions given below.

For pure rocket aircraft and, with a certain degree of approximation, for jet aircraft, the consumption per kg. gross weight and metre distance is at a minimum when the speed is the highest possible value and $(c_w/c_a)$ at a minimum ; this is attained by seeking the optimum altitude or suitably choosing the wing dimensions. If the aircraft and flying altitude are prescribed, the speed should be chosen in such a way that $(c_w^2/c_a)$ is at a minimum.

For these two classes of aircraft, the consumption per kg. gross weight and second flight duration is at a minimum when $(c_w/c_a)$ is also at a minimum.

For ram-jet aircraft, the consumption per kg. gross weight and metre distance will be at a minimum when the speed is as high as possible and $(c_w/c_a)$ $(c_a F/4F_1+1)$ minimum. If the wing characteristics and the flight altitude are predetermined, the speed must be chosen in such a way that $[c_w/\sqrt{c_a}(c_w F/4F_1+1)]$ is at a minimum.

If the polars are independent of the flying speed, as they are in the sonic and supersonic ranges, such simple relations can no longer be used.

The conditions also change in unsteady flight ; for instance, it is evident that the motorless supersonic flight of pure rocket aircraft will be best when $(c_w/c_a)$ is at a minimum.

3. *Flight Performance of Ram-Jet Aircraft.* The range $s$ of the subsonic jet aircraft, chemically-heated, in horizontal flight, is given by the following relation :

$$s = \frac{(v/a)^2 \, ln \, G_o/G}{2gc_p/H_u \cdot c_w/c_a \cdot (c_w F/4F_1+1) \cdot [1+(v/a)^2 \kappa gR/2{,}000]\kappa/gR}$$

whereby $v/a$ is the Mach number of flight, $G_o$ the initial weight and $G$ the end weight in horizontal flight (thus $\Delta G = G_o - G$ is the total fuel consumption), $g$ acceleration of gravity, $c_p$ the specific heat of the

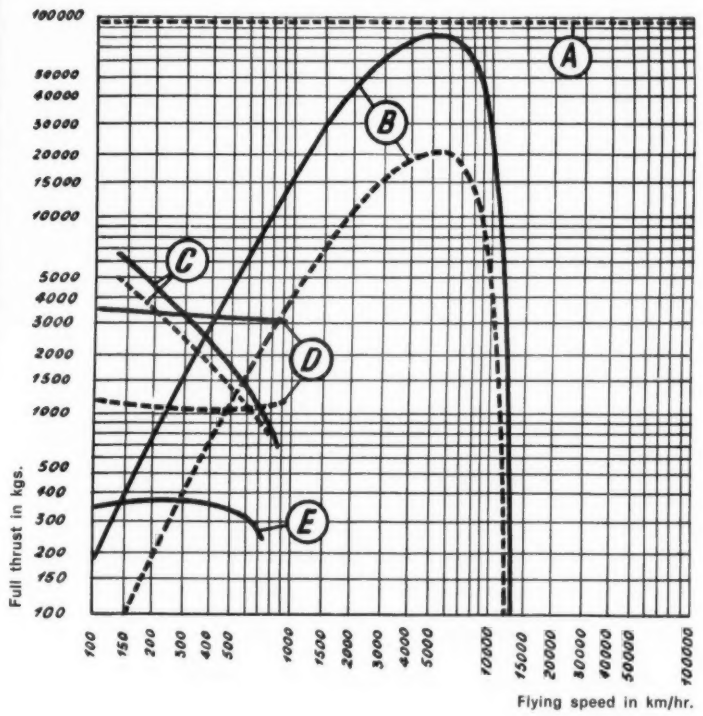



*Fig. 35: Full thrust of large engines at sea level (full line) and at 12,000 metres (dotted line).*
*A = 100-tonne rocket, B = 2,500-mm.-diameter ram-jet, C = 4,000-H.P. piston engine with propeller, D = axial-flow turbine of 1,250 mm. diameter, E = resonance duct of 560 mm. diameter.*

combustion gases at constant pressure, $F$ the wing area, $F_1$ the cross-sectional area of the air inlet into the cylinder, $R$ the individual gas constant, $\kappa$ its adiabatic exponent, and $F_2$ the frontal area of the duct.

If one accepts the relation $c_{w1} = a + bc_a^2$ for the aircraft polars and $c_{w2} = cF_2/F$ for the drag of the duct, one can determine an optimum ratio of the wing area $F$ to the frontal area of the duct $F_2$ under the condition that the fuel consumption per metre distance and kg. gross weight

$$\frac{dG}{Gds} = \frac{2g}{H_u}\frac{c_p}{c_a}\cdot\frac{c_w}{c_a}\left(\frac{c_w}{4}\frac{F}{F_1}+1\right)\frac{1+\left(\frac{v}{a}\right)^2\kappa\cdot gR/2{,}000}{\left(\frac{v}{a}\right)^2\kappa\cdot gR}$$

is at a minimum.

For example, one obtains for $a = 0.01$, $b = 0.07$, $c = 0.07$ and $F_1 = F_2 = 0.16$, an optimum value $F/F_2 = 11$.

If one uses the polar curve of the now determined aircraft at its most favourable point ($c_a = 0.382$ according to the above figures), one will fulfil all the conditions prerequisite to optimum range.

For a Mach number of $v/a = 0.9$ (which seems reasonable with the polar curve if the wing is sharply swept-back) and a weight of fuel amounting to 60 or 80 per cent. of the take-off weight $G_o$, the above formulae give a range of 5,280 or 9,150 kms., thus very interesting values which seem to show that the subsonic ram-jet aircraft with oil heating could be used for transportation purposes, as an unmanned transport, or as a long-range fighter.

It should furthermore be stressed that this result is independent of the flight altitude and the wing loading, *i.e.* it can be achieved at any flight altitude if a judicious selection of wing loading is made. Nevertheless, the wing loadings of below 500 kg/sq.m. which occur in practice, indicate flight altitudes of over 10,000 metres, which continue to increase during horizontal flight as a result of the reduction in wing loading.

One can present corresponding considerations for the ascent of chemically-heated subsonic ram-jet aircraft, thus for the minimum consumption per metre altitude gained and kg. gross weight, and one obtains for $F/F_2 = 0$ the most economic theoretical ascent, this being a vertical ascent. The practical consequences to be drawn are that aircraft which have above all to climb must feature a very small ratio of $F/F_2$, those which must simultaneously have good climbing and horizontal-flight characteristics (*e.g.* fighters) a value of $F/F_2$ of about 6, and primarily long-range aircraft a high value of $F/F_2$ of the order of 11, so that climbing and horizontal flight together always work out at an optimum. Finally, one can also vary the ratio $F_1/F_2$ which we have hitherto regarded as a constant on the basis of experience gained in conjunction with engines ; and in this way one meets with conditions that are a little more favourable. In conclusion, it must be noted that the range formula reveals the favourable influence of high wing-aspect ratio, and that the optimum combustion temperatures for climbing and horizontal flight are moderate.

The study of supersonic flight is a little more complicated and, in view of the very high engine efficiency and despite the less favourable lift/drag ratio, indicates ranges of the order of 10,000 kms. in pure horizontal flight, if this study is carried out with care.

Finally, as has been stated earlier, the utilisation of atomic energy in the subsonic and supersonic domains results at all flight altitudes in practically unlimited range and flight duration.

4. *Flight Performance of Long-Range Rocket Aircraft.* There are two fundamental flight procedures available to this category of aircraft : acceleration up to the moment the flying speed is equal to the efflux velocity, followed by flight at constant speed and reduced thrust ; or acceleration up to a speed such that the subsequent non-propelled gliding flight enables the required range to be attained. The latter procedure—and it is in this that it distinguishes itself absolutely from the former—leads to greater range and simpler rocket engines, the consumption remaining the same ; we shall restrict our considerations to this procedure.

The introduction to section *C* 1 of this article gives an idea of the ranges which may be realised by this procedure and also shows that by dividing the rocket into several stages, one can obtain initial gliding speeds

$$v_{1st} = k_1 c_1 \cdot ln\frac{G_o}{G_1+\Delta G_1} + k_2 c_2 \cdot ln\frac{G_1}{G_2+\Delta G_2} + \ldots k_n c_n ln\frac{G_{(n-1)}}{G_n}$$

($\Delta G$ is the empty weight of the carrier aircraft) which are much higher than those attainable by " single-go " propulsion $v_1 = k\ c\ ln\ G_o/G$, and that a large part of the dead weight does not need to be accelerated up to $v_1$, but is abandoned beforehand, with the result that $G_n \lesssim G$, and the range increases as a result of the multi-stage propulsion. For example, the initial gliding speed of a two-stage rocket aircraft is double that of a single-stage type, if $k_1 = k_2 = k$, $G_o/(G_1+\Delta G_2) = G_1/(G_2+\Delta G_2) = G_o/G$, $c_1 = c_2 = c$, from which it may be deduced that the ranges, according section *C* 1, are increased at least four-fold.

In the case of multi-stage rocket propulsion (*e.g.* supersonic catapult, carrier rocket as primary stages), the $v_1$ values at each stage simply add together ; then the values of $k$ must be ranged in suitable gradation and made to tend strongly towards unity in the higher stages. However, the multi-stage principle is mostly a stop-gap solution, and of little economic value if the efflux velocities are insufficient.

Indeed, if one applies this multi-stage principle of propulsion by super-imposing several aircraft one on top of the other, the total cost increases sharply and the procedure can in many instances become impossible owing to its lack of economy. In cases where economy plays no rôle—for instance in the event of a first flight through space —it can prove to be a very effective means of attaining this goal with moderate efflux velocities.

One way of improving the economic aspect is to place the first stage, in the form of a supersonic rocket catapult, on the ground.

If the aircraft is considered as a second-stage, with $G_1/G_2 = 10$, $c_2 = 3{,}000$ m/sec., $k_2 = 0.8$ and the first stage as a catapult with $G_o/(G_1+\Delta G_1) = 1.43$, $c_1 = 1{,}500$ m/sec., $k_1 = 0.92$, the end speed after the first stage will be $k_1 c_1\ ln\ G_o/(G_1+\Delta G_1) = 500$ m/sec., and after the second stage $v_{1st} = 500 + k_2 c_2\ ln\ G_1/C_2 = 6{,}000$ m/sec., against only about $v_1 = 5{,}500$ m/sec. without catapult. According to section *C* 1 of this article, the ranges in both cases are in the ratio of 17,480 kms. to 13,400 kms. ; the gain due to the catapult therefore amounts to about 30 per cent. and can be still more for higher values of $c_2$.

The entire flight then proceeds roughly as follows : the rocket aircraft is catapulted along a horizontal ground track of 3 kms. by means of powerful rockets functioning during approximately 11 seconds, until the aircraft has gained about 1½-times sonic speed ; subsequently, with a trajectory forming an angle of 30 deg. with the horizon (this inclination will later diminish), the aircraft rises under full thrust of its rockets, to attain altitudes of 50,000 to 150,000 metres and end speeds which are multiples of the efflux velocity. This ascent lasts four to eight minutes, during which time the fuel is consumed. At the end of the ascent, the rocket stops and the aircraft continues its course along a sort of wave-shaped trajectory with oscillations of decreasing amplitude, solely on its kinetic and potential energy.

Because of its wings and the supporting properties of its fuselage, the aircraft, descending along a ballistic curve, will bounce on the lower layers of the air and thus be thrown upwards again, just as a flat stone ricochets when thrown along the surface of a pond ; each plunge into the denser air will result in a part of the kinetic energy being consumed, so that the initially very long jumps will gradually become shorter, finally to transform into an even gliding flight. At

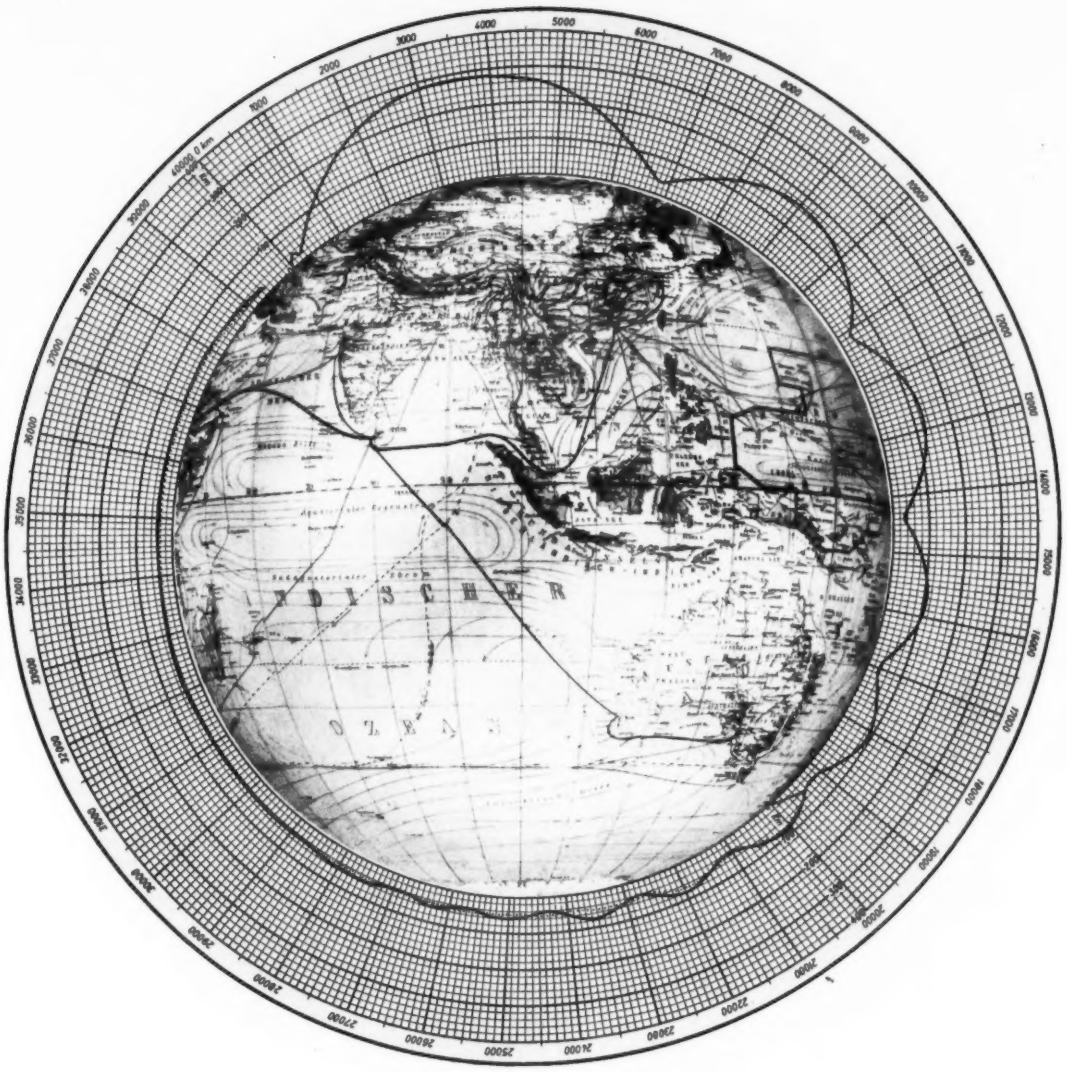



*Fig. 36 : Trajectory of a rocket bomber ($v_0$ = 7,000 m/sec.) drawn to an exaggerated scale ; bombs (3.8 tonnes) dropped after 19,200 kms. Great Circle distance, at 40,000 metres altitude and 6,060 m/sec. flyng speed.*

the same time, along the many thousands of kilometres of gliding trajectory, the flying speed will decrease from its high initial value to the normal landing speed.

Enormous flight trajectories of this kind, passing along the surface of the earth, are shown in Figs. 36 and 37 in exaggerated scale. As regards the length of terrestial long-range flight trajectories, these can be estimated by means of the relation contained in section *C* 1.

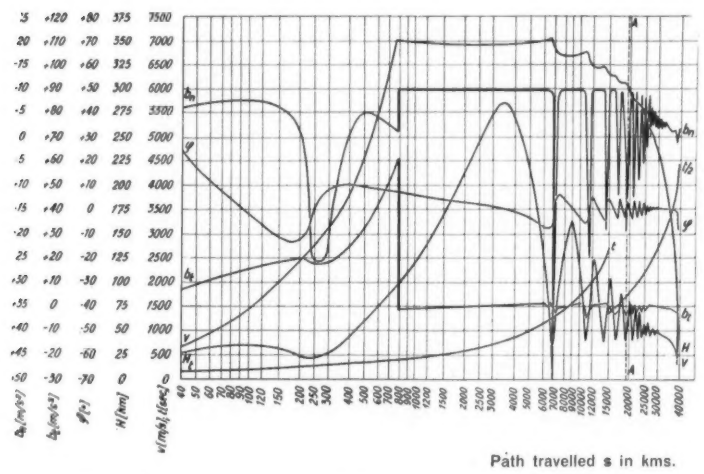



*Fig. 37 : Flying speed* v, *flight altitude* H, *trajectory inclination* $\phi$, *tangential acceleration* $b_t$, *normal acceleration* $b_n$, *and elapsed time* t *of the trajectory of a rocket bomber with* c = *4,000 m/sec.,* $v_0$ = *7,000 m/sec. and bomb-load* B = *3.8 tonnes dropped from 40,000 metres altitude* (A = *dropping point) at 6,060 m/sec. flying speed and 19,200 kms. distance from the take-off point.*

5. *Domains of Application of Atomic Ram-Jet or Atomic Rocket Aircraft.* The considerations made so far have shown that both chemically-fuelled ram-jet aircraft and chemically-fuelled rocket aircraft enable ranges of the order of 10,000 kms. to be attained, which may be even much more with chemical rocket aircraft.

At the same time, the operating costs and the flying speeds would seem to attain higher levels in the case of rocket aircraft.

With the introduction of atomic energy, the ranges of both these aircraft types will become unlimited, though this will be for entirely different reasons.

In the case of the ram-jet aircraft, the fuel consumption will be practically nil ; at speeds which one will be able to vary arbitrarily between $v/a$ = 0.6 and 3.5, and at altitudes below 30,000 metres, such an aircraft will fly as long as one wishes, being entirely manœuvrable thanks to the utilisation of the atmospheric air as a means of propulsion ; its flight will be characterised by the high proportion of transportable payload and the modest requirements as regards technical and organisational installations. It will represent a means of transportation which is in a sense earthbound ; as an instrument of warfare, it would be under the constant menace of hostile fighter aircraft and anti-aircraft defences.

For the pure rocket aircraft, on the other hand, the introduction of atomic energy in no way signifies the elimination of the masses to be taken on board ; if a trajectory becomes unlimited, this is alone

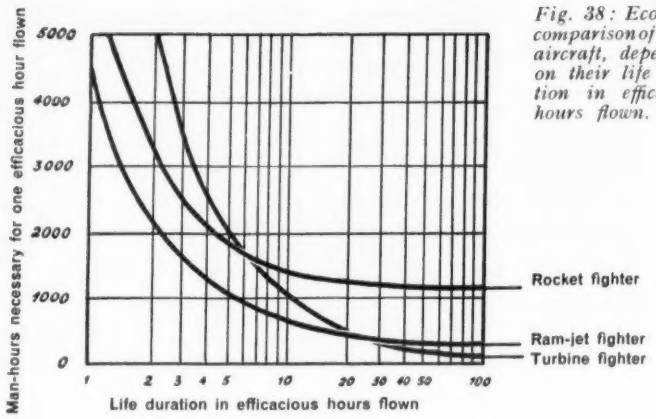



*Fig. 38: Economic comparison of fighter aircraft, depending on their life duration in efficacious hours flown.*

thanks to the extremely high flying speeds, which enable the aircraft to emerge definitely from the earth's atmosphere ; once it has started, the flight will only be able to be controlled within very narrow limits, since it will proceed according to the laws of motion of a celestial body. The payload will invariably represent a small part of the gross weight ; on the other hand, operations will demand considerable technical and organisational installations. It would seem to represent primarily an outer-terrestial means of communication, constituting a step along the road to inter-stellar flight ; as an instrument of warfare, it will probably be outside the scope of enemy action.

### F. *Economic Aspects*

In the assessment of the economic aspects of an aircraft, the usual computation of the operating costs is of essential importance only in connection with civil aviation, but is of no significance at all where military or scientific standpoints are concerned.

It is above all in the domain of scientific research that the ratio between the initial costs and the result to be obtained becomes intricate, since even the most far-sighted and cognisant of scientists is unable to predict the probability of the goal being reached.

The development of space weapons, the so-called V weapons, during the war in Germany, serves as an example of the considerable difficulty offered in this connection.

From the general point of view, the V-1 represented a particularly rational solution of the problem of transporting a given quantity of explosives over a given distance, coupled with a minimum of work and human risk. The degree of efficiency reached would have been still greater, however, had these devices attained the speeds and altitudes anticipated.

One cannot straight away ascribe a similar degree of efficiency to the V-2 in the stage of development it had reached when put into war-time operation, since the manufacture and operation of these rockets required far more work and material per tonne-kilometre of load carried, and these factors were not offset these rockets' immunity to attack by hostile forces.

Considered from another angle, the development of these two weapons, which consumed a considerable portion of the nation's intellectual and manual potential, appears as having been a waste in so far as at the time they were ready for operation, the need was not so much for offensive weapons as for a means of defence against air attacks, and the very potential which would have enabled such defensive weapons to be developed, had been expended on the V-1 and the V-2.

Looking at it from another aspect, the development of the liquid-fuel rockets of Oberth appears to have been more advantageous ; if these rockets had really constituted the beginning of the development of inter-stellar navigation, then the enormous expenses of all kinds involved in the development of the V-2 appear in an entirely different light.

The problem of the fighter aircraft furnishes a better example of what economy in military aviation can signify. Basing our views on the technical situation existing in Germany during the last years of the war, we see that the goal of war economy also tends in general to safeguard the national potential in man-hours, and to use it in a rational manner.

The mission of the fighter aircraft is to destroy enemy aircraft. If the number of aircraft destroyed is proportional to the hours flown, the total of the man-hours per efficacious hour flown, constitutes a given value which could serve as a basis for comparing different types of fighter aircraft.

If one furthermore disregards the costs which are common to every type of fighter, in other words the costs—very high—incurred by the crew, ground organisation, armament, and so forth, we then come to, for the specific supplementary costs coupled with each type (airframe, engine, fuel), the remaining costs presented in Fig. 38, expressed in man-hours per efficacious hour flown in combat against the enemy, in function of the life duration of fighter aircraft.

Since each kilogram of aircraft perhaps represents a hundred times the number of man-hours pertaining to a kilogram of fuel, expensive aircraft with low fuel consumption (turbo-jet fighters pure jet fighters) can only be more economic than cheap aircraft with high fuel consumption (rocket or ram-jet fighters) if they have a longer life duration.

In view of the fact that the life duration is especially short in the case of fighter aircraft, the price of the fuel consumed during this short life, even if the specific consumption is very high, plays but a small rôle when compared with the price of manufacturing the aircraft. The low manufacturing price of a fighter, for example, can therefore be fully exploited in this connection. The still very topical problem of unmanned aircraft in operation against terrestial and aerial targets also comes within the scope of this examination of the economic aspects of combat aircraft.

From a purely economic point of view, the losses in human life have much heavier consequences in wartime than the heaviest material losses.

These facts are the principle cause of the progressive mechanisation of war, which tends to diminish the number of individuals exposed to risk ; and these facts justify the utilisation of unmanned aircraft.

*Summary*

The prospects of jet reaction flight are manifold and interlaced. Four principle ways ahead are discernible, and these are presented by four types of prime mover : resonance ducts, propeller-turbines, ram-jets and rockets.

Looking ahead, the prospects of the resonance duct seem to become vague and to lose themselves along numerous small paths.

After a number of side roads which will continue to be trodden, the prospects of propeller-turbines, it would seem, must ultimately merge with those of the ram-jet ; and this latter engine type will probably provide the ideal means of propulsion for high-speed airliners encircling the globe.

The fourth way ahead, that of the rockets, seems to be destined to open to humanity the doorway to outer-terrestial navigation and inter-stellar flight.

# Recent Developments in Aeronautical Engineering

By Norman S. CURREY, Hatfield.

In this article, which casts light on a number of new trends, we shall only concern ourselves with the design, structural, and constructional aspects.

*Cemented Joints.*

The cementing of joints is one of the latest developments. " Reduxing " in Great Britain, " Cycleweld " in the U.S.A., and the " Araldite " process in Switzerland are some of the methods under development today.[1] It is carried out by applying various powders and syrups to the materials being joined, and then putting them under a heated press. After a specified time they are withdrawn, the surplus cement is cleaned off, a test is made of a small test piece inserted with each batch, and they are ready for use.

Flat parts, or parts with single curvature, involve a comparatively simple process. But if, for example, we were required to cement stringers to a large sheet with double curvature, a jig or forming tool would be required.

There are many advantages in using cemented joints :-

*a)* the aerodynamic efficiency of a surface free from rivet heads ;

*b)* even distribution of stress throughout the length of the stringer in a skin-stringer combination—in a riveted stringer the stresses concentrate at the rivet holes ;

*c)* in a pressurised cabin the leak rate through the skin-stringer combination is reduced appreciably, owing to the absence of rivet holes ;

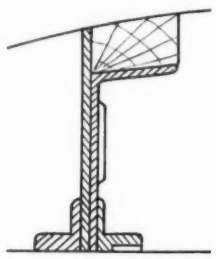
*d)* economic cemented combination of wood and metal (as in the D.H. " Hornet " wing spar and many reinforcing pieces).

A word may be said about the " Hornet " wing spar at this point. Due to the large cross-sectional area of wood that would be required, it was found impracticable to use a wooden tension boom—such as that used in its predecessor, the " Mosquito. " Choice was therefore given to the combination of wood and metal shown in Fig. 1.

Regarding the structural side of cemented joints, the weight of a cemented joint is approximately the same as that of an analogous riveted joint, but the strength is greater. In some tests carried out, a " Reduxed " joint was found to be three times as strong as a comparative riveted joint. When used to join the skin and stringers in a wing structure, it proves far superior to a comparative riveted structure—in the latter the buckles run through the rivet holes, where we have points of stress concentration. After a large number of reversals the rivet heads would either snap off or pull through the skin. This does not, of course, happen in the case of the cemented structure—the skin sticks firmly to the stringers until the final point of collapse.

[1] Cf. A. von Zeerleder : " A New Method for Joining Light Metals " in No. 3, Vol. II of " Interavia, Review of World Aviation, " pp. 31-34 ; and Directorate of Technical Developments (D.T.D.) Specification No. 775.

*Fig. 1 : Wing spar of the de Havilland " Hornet," a typical example of a high-strength cemented combination of wood and metal achieved with " Redux."*



Typical cases where " Reduxing " has been used are found in the floor of the Vickers " Viking " (Fig. 2), in the skin-stringer combinations of the D.H. " Dove " and in the wing spar of the D.H. " Hornet. "

*Materials.*

Recent developments in the metallurgical field include high-strength aluminium alloys of the R.R.77 series, and the new magnesium-zirconium alloys.

Among the R.R.77 series of alloys we have D.T.D.687 clad sheet, D.T.D.683 forgings, and D.T.D.693 tube. The predominant feature of these is the comparatively large percentage of zinc present. In D.T.D.687, a typical composition would consist of :-

| | |
|---|---|
| zinc | 4.5–6.5% |
| copper | 1.5% max. |
| magnesium | 2.0–3.5% |
| manganese | 0.2–1.0% |
| impurities (iron, silicon, titanium, etc.) | 1.3% max. |
| aluminium | the remainder. |

The cladding includes about 1.0% zinc.

This material must be heat-treated by a solutionising and precipitation process, endowing it with the following mechanical properties :-

| | |
|---|---|
| ultimate tensile stress | 30 tons/sq.in. min. |
| 0.1% proof stress | 26 tons/sq.in. min. |
| elongation | 8% min. |

In the D.T.D.683 forgings we may have an ultimate tensile strength as high as 35 tons per square inch.

Until recently, the sheet materials used for aircraft skins were mainly D.T.D.610 alclad, D.T.D.546 alclad, and D.T.D.390 alclad. The highest ultimate tensile strength value for any of these is in D.T.D.546—27 tons per square inch. This increase in strength makes it possible to use very small skin thicknesses for the fuselages on aircraft now being designed. In large aircraft operating at great altitudes with high differential pressures, we can bring fuselage skin gauges down to 22 S.W.G. (0.028 inches) at some points. The general decrease in gauge permitted by the use of D.T.D.687 may decrease the weight of an aircraft by several hundred pounds, particularly if we use it for stringers, bulkheads, floor skins, diaphragms, etc.

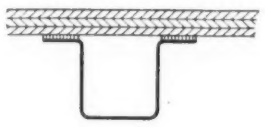


*Fig. 2 : In the floor of the Vickers "Viking," strips of birch veneer are " Reduxed " to light-alloy stringers and glued to the plywood floor.*

This weight can be still further reduced by using the new magnesium-zirconium alloys for such components as window frames, handles, control boxes, and brackets under fairly low stresses.

Until zirconium was introduced, the strength of magnesium alloys was as follows :-

| | |
|---|---|
| D.T.D. 285 castings | U.T.S. 13 tons per sq.in. 0.1% proof stress 6.5 tons per sq.in. |
| D.T.D. 120a. sheet | U.T.S. 16 tons per sq.in. 0.1% proof stress 7.0 tons per sq.in. |
| D.T.D. 259 extruded bar | U.T.S. 14 tons per sq.in. 0.1% proof stress 9.0 per sq.in. |
| D.T.D. 88b. forgings | U.T.S. 15 tons per sq.in. 0.1% proof stress 8.0 tons per sq.in. |

The addition of zirconium—developed, incidentally, by a British firm, Magnesium Elektron Ltd.—reduces the crystal size from about 0.2-0.4 mm. to 0.05-0.10 mm. across. The following properties may then be expected :-

| | |
|---|---|
| Elektron Z 5 Z castings | U.T.S. 16-18 tons per sq.in. 0.1% proof stress 9.5-10 tons per sq.in. |
| D.T.D. 629 sheet | U.T.S. 17 tons per sq.in. 0.1% proof stress 11 tons per sq.in. |
| D.T.D. 733 extruded bar | U.T.S. 23 tons per sq.in. 0.1% proof stress 17 tons per sq.in. |
| D.T.D. 619 forgings | U.T.S. 19 tons per sq.in. 0.1% proof stress 13 tons per sq.in. |

Comparing the properties of the old and the new types, a great increase in strength can be seen. The specific strength is, in fact, very high indeed.

In addition to using them for small components, such as those mentioned above, they are now being used as basic constructional materials for entire aircraft, such as the Planet " Satellite " (Fig. 3), Essex Aero " Sprite " and the Douglas " Skystreak. " Because of their low specific gravity, meanwhile, a very thick skin can be used, giving as great a strength and less weight than a comparative alclad skin. The advantages of this are :-

*a)* very smooth and aerodynamically-efficient skin, adapting itself extremely well to high-precision forming, as in laminar flow wings ;

*b)* rigidity of structure ;

*c)* few, if any, stringers required, thereby giving a very clean inside structure ;

*d)* ease of manufacture—the parts can simply be welded together.

The disadvantages are in the poor corrosion resistance of the alloy, and in its poor formability.

A typical composition of a magnesium-zirconium alloy is :-

| | |
|---|---|
| zinc | 4.5% |
| zirconium | 0.6-0.7% |
| magnesium | the remainder. |

This is actually the composition of the Elektron Z 5 Z castings. The wrought types have cadmium added up to 4%.

*Controls.*

Servo controls are now being used more and more as the loads on control surfaces increase.

For many years control surfaces have been successfully balanced against aerodynamic loads, but now, on high-performance aircraft, we must resort to power assistance to help the pilot.

The system is based on the principle of the hydraulic jack. Briefly, it works as follows : because of differing effective pressure areas on the piston owing to the area taken up by the ram-rod, a movement of the ram-rod can be obtained by applying pressure to both sides of the piston. If we apply pressure to the ram-rod side we obtain an opposite movement of the rod. The rod can therefore be controlled merely by controlling the pressure on the large side of the piston. For the jack to contract, pressure is applied to the small side, and for an extension, equal pressures are applied to both sides.

The type of valve used on most servo systems is the piston-type slide valve, as this has proved to be most efficient in reducing losses and operating loads. Meanwhile, other types of valve are in use, namely the rotary and poppet types. These are cheaper, owing to the lesser degree of accuracy required in their manufacture, but are not as efficient. The Dowty pre-selective flap system (servo controls are often known as " pre-selective " when applied to flaps) uses a rotary valve, as this eliminates the use of a differential lever. They are, however, of little use if any degree of pressure tightness is required.

Poppet types are cheap, simple, and provide very sensitive control with wide tolerances. However, they involve the use of springs, in order to hold the valves on their seats. The loads thus produced, though they may be small, are unacceptable.

A certain percentage of " feel-back, " or manually-provided operating load, is required ; and to this end the variable " feeling link " is provided, to connect the control rod, jack, valve, and control surface (Fig. 4). Ten to twenty per cent. feel-back should be sufficient.

*Fig. 3 : Magnesium alloy of high specific strength is used as basic constructional material in the Planet " Satellite " four-seater personal aircraft. The experimental model shown here features many rivets which will presumably be replaced by seam-welded joints in the final versions, since such Elektron sheet lends itself well to welding.*

The Hobson power control system is normally irreversible and provides continued irreversibility if the hydraulic power fails. The latter is produced by a servo motor. A jack and valve are linked in such a way that, if the operator disturbs the valve's equilibrium, the jack is set in motion and, at a point determined by the movement imparted by the operator, restores the valve to a position of equilibrium and thus halts further motion. Limited valve travel enables the load to be operated manually in the event of a hydraulic power failure. When this occurs, the operator has direct manual control, the irreversibility having been lost.

It is often found desirable to have the controls (ailerons, elevators, rudder) irreversible ; mass balancing may then be avoided without there being any danger of control flutter.

Servo controls do, in general, save weight, particularly in large aircraft. They are not a new invention, by any means—they were first exhibited in the 1938 Paris Aero Show by the Dowty and Messier Companies—but they have only recently started to be used on aircraft.

*Pressurising.*

Another comparatively recent development is pressurising. A great contributing factor towards its development is the desirability to use jet engines, which, we know, only reach maximum efficiency at great altitudes.

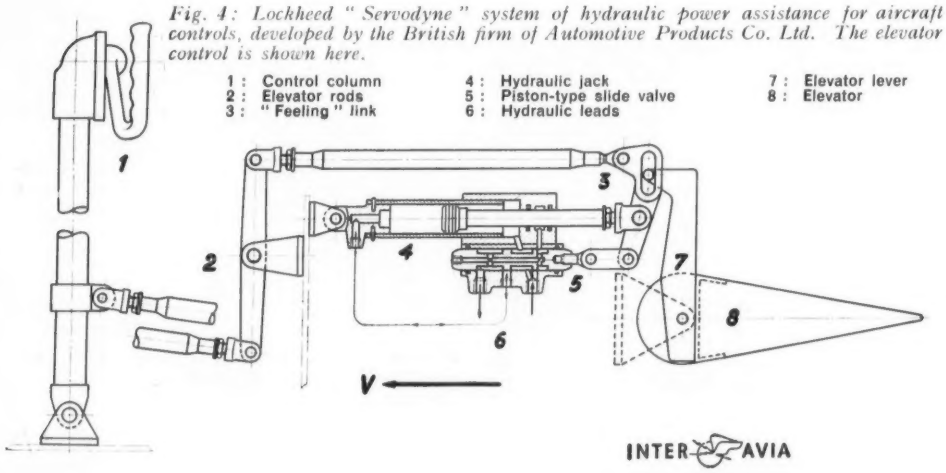



*Fig. 4 : Lockheed " Servodyne " system of hydraulic power assistance for aircraft controls, developed by the British firm of Automotive Products Co. Ltd. The elevator control is shown here.*

If we are to travel at high altitudes we are left with three alternatives when designing the passenger cabin. We can :-

*a)* fill the cabin with air at the same rate at which it leaks out ;

*b)* fill the cabin with air carried in high pressure storage bottles ;

*c)* pump more air in than is required, and rely on some form of valve to maintain the correct level.

Method *(a)* can be ruled out simply because we have no accurate way of finding the exact leak rate. In addition to this, the air would become stale.

Method *(b)*, while being suitable for aircraft flying at extremely great altitudes, is not utilisable in present-day economic airliners. Its main disadvantage is its very great weight.

Method *(c)* is the method in use today.

Briefly the system is as follows : air is taken in and filtered from a duct placed well away from exhaust fumes, slipstream, etc. It then passes through a blower, usually mounted on the engine, and continues through the coolers to the silencers. After passing through the humidifier and heater it is blown into the cabin. Contaminated air from the lavatories and kitchen is exhausted through a discharge valve, whilst the rest of the air is re-circulated after having been mixed with fresh incoming air. The order in which these various components occur may vary slightly in different aircraft.

Many articles have already been written on pressurising, describing the various parts of the system, with the amount of air required for each passenger, the amount of water vapour that should be present, the ideal temperature, etc.,[2] so I will not go into the details of the system. Instead, I will review the latest developments.

Aircraft are now being designed to fly at altitudes of about 40,000 feet and at speeds around the 500 m.p.h. mark. To carry, say, 30 passengers in reasonable comfort in these conditions provides quite a big pressurising problem. The differential pressure between the cabin and the atmosphere is 8.10 pounds per square inch at these altitudes ; *i.e.* a cabin altitude equivalent to 8,000 feet has to be maintained. This creates many difficult stressing problems on the fuselage—such problems as windows blowing out, skin tearing out at rivet seams, and exorbitant leak rates through the rivet holes, seams, and so forth.

The output of the cabin blower falls off as the altitude increases ; for instance, a Marshall cabin blower producing 30 pounds per minute at 3,000 feet only produces 15 pounds per minute at 25,000 feet, and above this altitude its efficiency falls off rapidly.

The centrifugal compressor is one method of overcoming this. It is far more efficient at high pressure ratios. The disadvantage of this type of compressor, however, lies in its mechanical intricacies—its speed at ground level must only be one quarter of that at maximum altitude. The reason for this is that, in order to decrease the power consumption and heat production near the ground, the compressor speed must be varied inversely as the density.

[2] Cf. " Interavia Review " No. 2, Vol. III, pp. 87-90 : " High-Altitude Flight and Air-Conditionad Cabins. "

Humidity control is still in an early stage of development, though several systems have been proposed. Water can be boiled and the steam passed into the air-stream, or can be finally sprayed into the ducts near the blower. Another method is to saturate the air fully at 50 deg. F. and, after heating it to 68 deg. F. (the ideal temperature), the air will be at the ideal humidity of 50 per cent. This system involves the use of a refrigerator and re-heater.

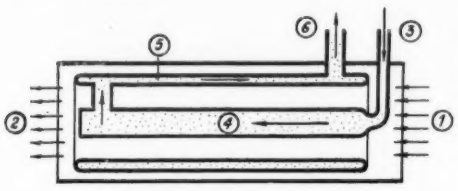



*Fig. 5: Diagrammatic view of a cabin air heater.*

1 : Cabin air entry
2 : Cabin air ejection
3 : Combustion air entry
4 : Petrol burner
5 : Exhaust gas jacket
6 : Gas exhaust

Present types of discharge valve are built in duplicate as a safety measure. The inwards relief valve, which was combined with the discharge valve in the wartime Westland valve, is now a separate component. Its use is to control the cabin pressure in a rapid descent and also to act as a ground-conditioning valve.

The heating may be done by a tube of burning petrol passing through the centre of the air duct, with the combustion gases entering the discharge through separate ducts on the underside of the fuselage (Fig. 5).

In future developments we may see the disappearance of such parts as astrodomes —when these blow off at high altitudes they can have disastrous consequences. This blowing-out at altitude is one of the major problems being tackled today (cf. Figs. 6 and 7).

*Power.*

At the beginning of the last war the only power plants in use were the conventional piston engines. Now, however, only eight years later, we see propulsion by piston engines driving propellers, gas turbines driving propellers, pure jet engines, rockets, and athodyds.

It has been said that within another eight years piston engines will disappear completely and be superseded by gas turbines, etc. Whether or not we shall see such a great change in such a short time is a very debatable point, but one thing is certain: all types of piston engine now have their contemporaries amongst the gas turbines. Gradually superseding piston engines such as Rolls-Royce "Merlin" and Bristol "Centaurus" types are such pure jet engines and propeller-turbines as the de Havilland "Ghost" and "Goblin," Rolls-Royce "Nene," Bristol "Theseus" and "Proteus." In the lower horsepower class we have the Armstrong-Siddeley "Mamba," Napier "Naiad" and the Roy Fedden "Cotswold." To replace the "Gipsy" series of engines, there is the de Havilland H.3, which is said to be in the development stage.

There are many disadvantages in the present-day types of pure jet engine; but they will eventually be overcome, just as the "teething troubles" in piston engines were overcome. The fuel consumption of pure jet engines varies a great deal with altitude and speed. Take the D.H. "Ghost" for example: at sea level and 10,000 r.p.m. we have a fuel consumption of 700 gallons per hour at 600 m.p.h. With the same speed at 50,000 ft. we only use 130 gallons per hour. The inference seems to be, therefore, that pure jet engines will be used for high-speed, long-distance, high-flying, pressurised airliners such as the projected D.H. 106. "Comet." The operating costs in a case like this would not be unreasonable, particularly when the shorter trip duration is considered.

The Bristol "Theseus" propeller-turbine engine was designed to give a power output and a fuel consumption comparable with that of a piston engine at 300 m.p.h. and 20,000 ft. Then, as the altitude and speed are increased, the gas turbine becomes the more efficient. We therefore see the propeller-turbine as the "halfway house" between the ultra-high-speed, high-consumption pure jet, and the comparatively low-speed, low-consumption piston engine.

*Fig. 8: The utilisation of magnesium alloys, with a specific gravity of 1.8 (0.065 lb./cu.in.), in wing construction enables thicker skin to be used, giving great rigidity of structure and eliminating the need for stringers.*

Rockets, while being used to propel certain supersonic experimental aircraft, are not likely to be employed as a means of propulsion for many years to come. Their main use will be for assisted take-offs.

Certain aerodromes on the airline routes of the world have not sufficiently long runways for some of the aircraft being developed today. In some cases, such as at Nairobi and Johannesburg, it is due to the altitude of the aerodrome. If, then, we are still to operate our large high-speed airliners over these routes, some form of rocket-assisted take-off is indicated unless we are to reduce the payload drastically.

Among the types of rocket being tested today are the Walter-type rocket motors using permanganate and hydrogen peroxide. These may give up to 5,000 lbs. thrust for a weight of about 420 lbs. The fuel consumption is rather high—19.5 lb./lb.hr. in a recent test—so it is very uneconomical to keep the motor working for more than, say, ten seconds when using it for assisted take-off purposes.

Athodyds are in a very early stage of development at present, most of the research on them having been carried out by the Germans during the last few years of the war. They only become efficient at speeds of about 500 m.p.h. upwards, so that some other means of propulsion must be used to reach this speed. Once this speed has been reached, the "ram effect" in the duct finally becomes effective.

*Stress Analysis.*

Recent stressing developments include Mr. Russell's (of The Bristol Aeroplane Co.) new ideas. He says that most of the strength of a wing is in its front portion, and that the ribs aft of the front spar and the trailing portion contribute very little to the strength. Six tons could have been saved apparently on the Brabazon I wing if it had been re-designed on these lines.

In certain new and projected aircraft, wing bending moments are being taken, not by the spar booms as in the past, but by the thick wing skin. In high-speed aircraft it is in any case essential to have a thick skin so as to obtain a very smooth, very strong, and very accurately-formed wing (cf. Fig. 8).

Gust loads are now becoming a very real problem to the stress analysist. In our large, high-speed, high-flying airliners, 50-foot-per-second up-gusts put large loads on many parts of the structure which at lower altitudes and speeds would not normally be affected by gusts.

All these recent developments have a bearing on the actual production methods adopted—and they have also developed a great deal recently. But that is another story!

*Fig. 6: For long-distance over-water flights, airliners have hitherto been fitted with an astrodome, a plastic bubble over the navigator's station, for taking sextant readings on celestial bodies. These astrodomes are notoriously apt to "blow out."*

*Fig. 7: Pan American Airways have recently conducted successful tests with a new periscopic sextant, which might bring about the elimination of the astrodome. In this picture the transparent bubble is provisionally covered by a metal hood.*

# A Short Guide to Radio Aids used in Air Navigation

The domain of radio aids to air navigation has probably received more impetus in the last few years than any other branch of aeronautics. Its meteoric development has given rise to a plethora of new methods and devices. In consequence, so many new terms have been coined that even those persons actively engaged in aviation are compelled to keep well on their toes in order to stay abreast of the air age. Though the inventors of these new terms have taken after medical scientists and borrowed indiscriminately from Greek and Latin—their philological achievements are sometimes enough to make Pindar and Ovid turn in their graves—English is nevertheless the leading language in the domain under consideration, just as it is throughout aeronautics.

The English-speaking aeronauts are therefore considerably luckier than their colleagues from other countries, in so far as there does at least exist a respectable amount of literature on air navigation written in English. But a " bogey " common to all nationalities is constituted by the multitude of abbreviations, helping to make the artificial language of radio navigation even more incomprehensible.

It may therefore be profitable to try to bring light into this polyglottic perplexity of air navigation by confronting the principal terms with their foreign-language counterparts, and also by briefly explaining the function of the most important systems.

*The Radio Waves*

Let us commence with the " pillars " used by all radio aids to air navigation, the invisible electromagnetic waves, commonly known as *radio waves*. We shall mention the following types :—

A1 : continuous waves (CW) of which the amplitude or frequency is varied by telegraphic keying ;

A2 : modulated continuous waves (MCW) of which the amplitude or frequency is varied periodically at audible frequency, combined with telegraphic keying ;

A3 : sound modulated waves (Voice) are continuous waves of which the amplitude or frequency is varied at audible frequency ;

(In television, use is made of A4 waves, which are similar to the A3 type, except that they are modulated at frequencies exceeding the audible range.)

B : damped waves (Sparks) of which the amplitude decreases progressively after it has reached its maximum.

Recently, increasing preference has been given to modulation of the frequency rather than the amplitude ; B waves are only used in emergency cases for telegraphy nowadays.

According to the number of their oscillations per second, in other words their frequency, which is measured in thousands or millions of cycles/second, *i.e.* in kc/s. or Mc/s., radio waves are classified as follows :—

1) *VLF* (very low frequency) waves, of below 30 kc/s.

2) *LF* (low frequency) waves, of 30-300 kc/s.

3) *MF* (medium frequency) waves, of 300-3,000 kc/s.

4) *HF* (high frequency) waves, of 3-30 Mc/s.

5) *VHF* (very high frequency) waves, of 30-300 Mc/s.

6) *UHF* (ultra high frequency) waves, of 300-3,000 Mc/s.

7) *SHF* (super high frequency) waves, of 3,000-30,000 Mc/s.

The two last types of wave are also called, because of their wavelengths, decimetre and centimetre waves.

Since all radio waves are propagated at the speed of light (300,000 kilometres per second), the wavelength can be obtained by dividing this speed by the frequency. The lower-frequency types of wave remain within the earth's atmosphere, so that they can be broadcast and received over great distances, despite the earth's curvature.

Radio waves are produced by many types of transmitter, and radiated by aerials which may be non-directional, directional or rotating ; received through directional or non-directional aerials ; converted by receivers into visual or aural signals. They can be diverted or reflected by obstacles and subsequently returned to their point of departure. Use of this reflective property is made in radiolocation (radar), in order to measure distances and obtain position fixes. For this purpose, use is made either of frequency-modulated continuous waves (*e.g.* in radio altimeters) or of the pulses of amplitude-modulated waves, in which case periodic pulses of millionths of a second duration are emitted, followed by silence intervals of 0.5 to 2 thousandths of a second. In the first case, the distance is obtained by frequency comparison, and in the second case by measuring the time required for the pulse to travel to and fro.

*The Basic Procedures*

1) Wireless telegraphy (W/T)
2) Radio telephony (R/T)
3) Television
4) Beacon systems
5) Direction-finding (D/F)
6) Radar systems (RADAR = *RA*dio *D*etecting *A*nd *R*anging)

These basic procedures serve on the one hand for communications (air-ground, ground-air, aircraft-aircraft, ground-ground) and on the other hand for radio navigation over habited and uninhabited areas, the safe execution of blind flights and all-weather landings (IFR - Instrument Flight Rule operations) and air traffic control ; for which purposes they are combined in many ways so as to form contrasting systems which, despite all ICAO's efforts, are by no means yet standardised.

This applies primarily to the innumerable methods, systems, devices and ... terms used in radio navigation and air traffic control, which are grouped together in the accompanying table. In order to find further established terms for the definitions contained in this table, we shall first consider the radio waves at those points where they are produced and received.

*Transmitters, Receivers and Aerials*

In addition to pure *transmitters* on the one hand and pure *receivers* on the other, there exist many types of combined station in aeronautical radio, which may be placed under the headings of *transmitter-receivers* and *receiver-transmitters*. Apart from communications—which will not be discussed further here—they are mostly used in conjunction with radar, whereby it is important to distinguish whether the re-

ception follows the transmission or vice versa. Radar devices of the first category are therefore known as *radar stations*—contrary to *radar beacons* (responders, transponders, repliers), which do not send a responding pulse until they have received an interrogation pulse, the responding pulse usually being emitted on a different frequency.

By coupling them with *special aerials*, all TRANSMITTERS can be used for emitting in one specified direction, or for sending out different radio waves in different directions ; when simple T or mast aerials are used, the emission is identical in all directions. Stations of the last-mentioned type, as for instance standard airborne transmitters or radio transmitting stations (on or off aerodromes), are therefore best called *radio stations*. Providing ground radio stations are erected exclusively for radio navigation (*e.g.* compass locators, M-markers), they are also known as *non-directional* beacons. Distinction must be made between these and the directional transmitters or *directional* (radio range) beacons.

The word " beacon, " as we know, means a signal or signal-fire on a pole or a hill, eventually a lighthouse ; it is meant to serve as a guide or a warning. In a way this describes the radio beacon's function in air navigation. Though it does not provide a visible landmark, it has an *established position*, thus enabling a pilot to take a bearing on it. If it is a directional type (*e.g.* radio range beacon) it furthermore radiates waves in a *specific direction*, thus providing guiding lines for the aircraft navigator or pilot. In this way, of course, it constitutes an invaluable aid in bad visibility conditions, when mere visual aids would be of no avail.

It will be profitable to note two ICAO definitions here. " *Non-directional* (as applied to radio aids to air navigation) : radiating without discrimination, as to azimuth, and without creating discrete paths in space. *Omni-directional :* providing an infinite number of discrete paths in space throughout 360 degrees of azimuth."

According to the type of beam array they emit, directional radio beacons can be :—

1) Marker beacons
2) Radio range beacons
3) Rotating radio beacons

*Marker beacons* send out elliptical, cone-, or fan-shaped beam arrays (usually on VHF) in *vertical* direction, which can only be received in an aircraft flying directly over the beacon. Their purpose is to provide occasional position fixes along airways and approach paths.

*Radio range beacons*, on the other hand, emit two or more beam arrays, not in vertical but in other directions, and in such a manner that an aircraft flying in their plane of symmetry receives a characteristic signal. There exist *simple* types, as for instance localiser and glide-path transmitting stations; *multiple* types, such as two- and four-course radio range beacons ; and even *omni-directional* radio range beacons. The latter emit waves in all directions but, according to the position of each wave relative to the north, with specifically varied characteristics, so that the navigator or pilot (or automatic airborne equipment, *e.g.* omni-range converter) can determine the azimuthal angle of the wave being received. It is for this reason, therefore, that ICAO makes a sharp distinction between omni-directional and non-directional beacons.

*Rotating radio beacons* mostly emit only one directional beam, though this is rotated at an accurate and relatively slow angular velocity. If another signal is broadcast non-directionally in the moment the rotating beam passes through the north, then—just as in the case of lighthouses or lightships at sea—the direction of this beam relative to the north (thus the azimuth) can be determined simply by measuring the time interval between the signals. Meanwhile, however, there also exist rotating beacons for which the momentary transmitting direction is communicated through speech modulation of the radiated wave ; or stations with several arrays, as for instance the Consol stations, which send out $5 \times 60$ dots and $5 \times 60$ dashes on swinging beams, one tenth of which are received (and counted) on board the aircraft.

Similar to transmissions, RECEPTIONS can also be non-directional or directional, according to whether a *simple* aerial or a *D/F aerial* (loop aerial ; Adcock system) is used. In the case of directional reception, not only is the actual message received, but also the direction from which it comes ; this is determined either relative to the aircraft's longitudinal axis (in *airborne D/F receivers*) or to the true or magnetic north (in *ground D/F receivers*). If the radio waves are radiated in a specified direction, *i.e.* if they are emitted by directional radio beacons, they can be received through simple aerials only. For receiving from certain directional beacon systems, as for instance Consol and MF or VHF rotating beacon systems, standard receivers suffice. For more complicated beam array systems, however, special marker receivers, omni-range converters, glide-path receivers, etc. are necessary.

The TRANSMITTER-RECEIVERS (transceivers) of ground radar stations mostly work with rotating or swinging directional aerials for determining the angles of azimuth and elevation of the returning waves. Aircraft radar stations may be fitted with rotating aerials (*e.g.* airborne radar), directional aerials (as used for gun aiming at night), as well as non-directional aerials (*e.g.* Distance Measuring Equipment). On the other hand, the RECEIVER-TRANSMITTERS of ground radar beacons emit only directional (*e.g.* BABS beacon) or non-directional responding pulses (*e.g.* Eureka) ; airborne radar beacons, for identification, air traffic control, collision warning, etc. (responders and transponders) have, of course, to broadcast non-directionally.

*Radio Aid Systems.*

Now that we have acquired a number of principal terms used in air navigation, which will facilitate an understanding of the definitions, let us turn to the separate methods and systems. An explanation in table form is the most appropriate way of clarifying this complicated picture. Based on their basic purposes, the systems are listed in the following order :—

COMMUNICATIONS AND SIGNALLING
- Non-Directional Transmission and Reception (1)
- VHF Marker Beacons (2)

DIRECTIONAL RADIO BEACONS
- Radio Range Systems (3, 4, 5)
- Rotating Beacons (6, 7, 8)

DIRECTION-FINDING
- Aircraft D/F and Homing (9, 10, 11)
- Ground D/F (12, 13)

RADIOLOCATION
- Radio Altimeters (14)
- Airborne Radar (15)
- Radar Beacon Systems (16, 17, 18)
- Hyperbolic Navigation (19)

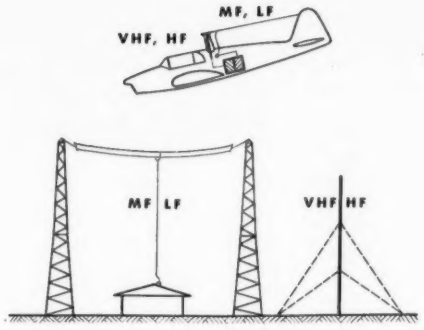
ALL-WEATHER LANDING
- Descent through cloud (20)
- Orbitting (21)
- Beam Approach (22, 23)
- Radar Approach (24, 25)

RADAR AIR TRAFFIC CONTROL AND COMBINED SYSTEMS
- Airport Control Radar (26)
- Airfield Surface Movement Indication (27)
- Combined Radar-Television (28)

Alongside the definitions of 28 principal systems are the names or terms pertaining to the chief items of equipment. It should be mentioned that many of the artificial words, as for example " Lanac, " " Navar, " " Teleran, " etc., explicit as they may sound, are nevertheless only manufacturers' names and do not denote actual methods ; they should therefore be regarded merely as concrete examples of the principles under consideration. The alphabetic list of the most frequently used abbreviations completes the table ; the simplified diagrams serve to explain the functional principle of each system.

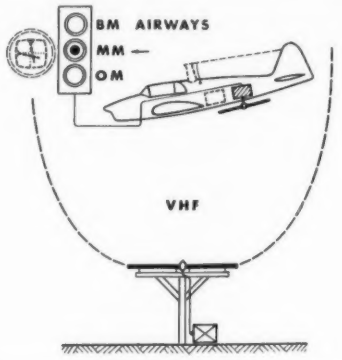
## COMMUNICATIONS AND SIGNALLING

| 1 NON-DIRECTIONAL TRANSMISSION AND RECEPTION | ÉMETTEURS ET RÉCEPTEURS NON DIRIGÉS | EMISORAS Y RECEPTORES NO DIRIGIDOS | RUNDSTRAHLSENDER UND UNGERICHTETE EMPFÄNGER |
|---|---|---|---|
| AERODROME RADIO STATION | STATION RADIO D'AÉRODROME | ESTACIÓN RADIO DE AERÓDROMO | FLUGPLATZ-RADIO-STATION |
| AIRCRAFT RADIO STATION | STATION RADIO D'AÉRONEF | ESTACIÓN RADIO DE AERONAVE | FLUGZEUG-RADIO-STATION |
| MF COMPASS LOCATOR | RADIOPHARE CIRCULAIRE | RADIOFARO CIRCULAR | ZIELFLUG-HILFSSENDER |
| M-MARKER | BALISE M (NON-DIRECTIONNELLE) | BALIZA M (NO-DIRECCIONAL) | BEREICH-ABGRENZ-SENDER |




Transmitting and receiving ground stations, established in aerodrome vicinity, are used for communications or D/F flight ; LF and MF waves usually radiated or received through T-aerials, HF and VHF waves through mast aerials. Airborne transmitters and receivers likewise have T-aerials (or L, V, or retractable trailing aerials) for LF and MF, and mast aerials for HF and VHF waves.

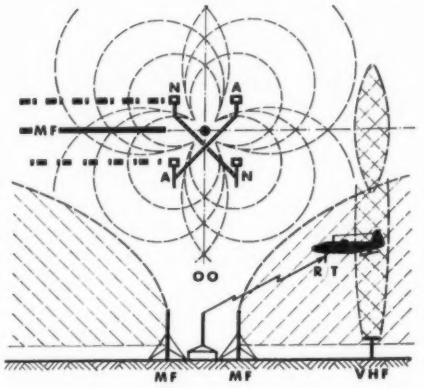
| 2 VHF MARKER BEACONS | RADIOBALISES VHF | RADIOBALIZAS VHF | VHF-SIGNALBAKEN |
|---|---|---|---|
| Z-MARKER | RADIOBALISE Z | RADIOBALIZA Z | Z-STANDORT-SIGNAL-BAKE |
| FAN MARKER | RADIOBALISE EN ÉVENTAIL | RADIOBALIZA EN ABANICO | FÄCHER-SIGNALBAKE |
| OUTER AND MIDDLE MARKER (OM,MM) | RADIOBALISE EXTÉRIEURE, RADIOBALISE INTERMÉDIAIRE | RADIOBALIZA EXTERIOR, RADIOBALIZA INTERMEDIARIA | AUSSEN- UND MITTEL-SIGNAL |
| BOUNDARY MARKER (BM) | RADIOBALISE DE DÉLIMITATION | RADIOBALIZA DE DELIMITACIÓN | PLATZ-EINFLUGSIGNAL |




Vertically-radiated transmissions from VHF radio beacon stations (mostly 75 Mc/s.) are received in the aircraft as visual and/or aural signals, informing the pilot that he is over an established point along an airway or approach beam. The Z-marker indicates, in a cone of silence, the location of a radio station.

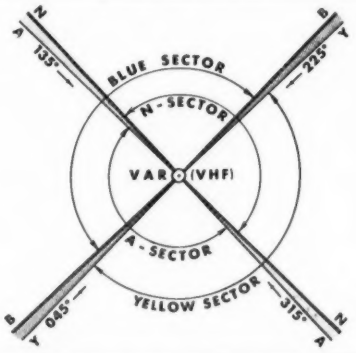
## DIRECTIONAL RADIO BEACONS

| 3 LF AND MF RADIO RANGE | RADIOPHARES D'ALIGNEMENT LF ET MF | ESTACIONES DE RADIOALINEACIÓN LF Y MF | LF UND MF LEITSTRAHL-BAKEN-SYSTEM " RADIO RANGE " |
|---|---|---|---|
| BEAM | FAISCEAU (TRAIT CONTINU) | HAZ (TRAZO CONTINUO) | LEITSTRAHL |
| IDENTIFICATION SIGNAL | SIGNAL D'IDENTIFICATION | SEÑAL DE IDENTIFICACIÓN | STATIONS-RUFZEICHEN |
| CONE OF SILENCE (00) | CONE DE SILENCE (00) | CONO DE SILENCIO (00) | SCHWEIGEKEGEL (00) |
| STATIC DISTURBANCE | PARASITES ATMOSPHÉRIQUES | PARÁSITOS ATMOSFÉRICOS | ATMOSPHÄRISCHE FUNKSTÖRUNGEN |



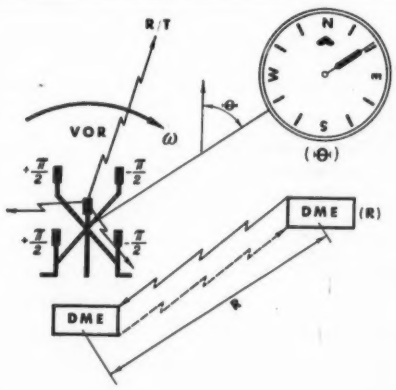

U.S.-adopted method of short-range navigation along airways established by a network of LF or MF directional-transmitting stations ; Adcock aerial systems each send out 2 A and 2 N beams in interlocking sequence so that a continuous (" on-course ") signal is heard in their plane of intersection. Position " fixes " occasionally indicated by fan-markers and M-markers placed at established points along airways : R/T usually provided through centre aerial of range station.

| 4 VHF FOUR-COURSE VISUAL-AURAL RADIO RANGE (VAR) | RADIOALIGNEMENT VHF OPTIQUE ET ACOUSTIQUE, QUATRE CAPS | RADIOALINEACIÓN VHF ÓPTICA Y ACÚSTICA, TETRA-DIRECCIONAL | OPTISCH-AKUSTISCHES VHF LEITSTRAHLBAKEN-SYSTEM (VAR) |
|---|---|---|---|
| BLUE SECTOR | SECTEUR BLEU | SECTOR AZUL | BLAUER BEREICH |
| YELLOW SECTOR | SECTEUR JAUNE | SECTOR AMARILLO | GELBER BEREICH |
| N-SECTOR | SECTEUR N | SECTOR N | N-ZEICHEN-BEREICH |
| A-SECTOR | SECTEUR A | SECTOR A | A-ZEICHEN-BEREICH |




A U.S.-adopted system comprising VHF transmitting stations which send out aural (A and N in morse) signals along two courses and visual (blue and yellow) signals on the other two ; the latter can be read off the ILS localiser indicator. It works more accurately in mountainous regions than the MF range system (3) does, and forms a transitional aid between the latter system and the VHF omni-range (5).

| 5 VHF OMNI-(DIRECTIONAL RADIO) RANGE (VOR) | RADIOPHARES D'ALIGNEMENT VHF OMNIDIRECTIONNELS | ESTACIONES DE RADIOALINEACIÓN VHF OMNIDIRECCIONALES | VHF ALLRICHTUNGS-LEITSTRAHLBAKEN-SYSTEM |
|---|---|---|---|
| BEARING INDICATOR | INDICATEUR DE RELÈVEMENT | INDICADOR DE MARCACIÓN | AZIMUT-ANZEIGER |
| SPINNING FIELD PATTERN | CARACTÉRISTIQUE TOURNANTE | CARACTERÍSTICA GIRATORIA | DREHENDE CHARAKTERISTIK |
| AUTOMATIC COURSE COMPUTER | CALCULATEUR AUTOMATIQUE DE CAP | CALCULADOR AUTOMATICO DE RUMBO | AUTOMATISCHER KURS-RECHNER |
| DISTANCE MEASURING EQUIPMENT (DME) | DISTANCEMÈTRE DE BORD DME | DISTANCÍMETRO DE BORDO DME | ENTFERNUNGSMESS-GERÄT DME |




Projected short-range navigational system comprising a network of VHF beacons with Adcock aerials having a spinning field pattern, for determination of azimuth (by phase comparison) by automatic means on board the aircraft. If DME (radar) beacons are installed on the ground and DME in the aircraft, it is also possible to effect distance measurements.

*(Table to be continued next month.)*

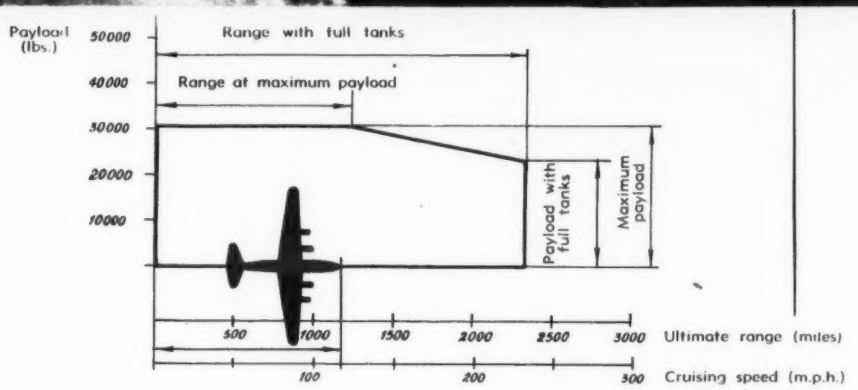
XUM

# Four-Engined Commercial Transports

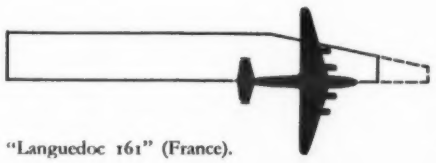
*This compilation is a complement to the review of twin-engined commercial transports which appeared in the October issue.*

In the last issue we stated that the commercial transport, considered from a general point of view, commands our attention as *the* aircraft of today. It may be said that this statement applies with particular emphasis to the four-engined types. Indeed, airline services over short and medium routes, and the twin engined airliners built for this purpose, are primarily the result of pre-war development ; and even today the majority of aircraft flying such routes can be traced back to the '30's. On the other hand, the flying equipment for long-range civil aviation, the big four-engined types, took shape many years later.

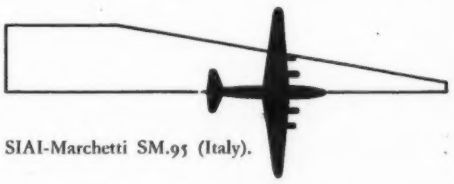
True, something in the nature of long-range air services — though with many intermediate landings — existed before the war on the so-called "Empire Routes" of the colonial powers, for which a number of four-engined landplanes and flying-boats were used ; but the Armstrong Whitworth "Ensign," the de Havilland "Albatross," the Short "Empire" and "G-Class" flying-boats, the Latécoère and Lioré & Olivier four-engined types, have already retired from service. The four-engined commercial transport, in its present standardised form, is rather derived from those types designed just before the outbreak of war to enable the American airline companies to inaugurate non-stop transcontinental services. When the U.S.A. entered the war, the first Boeing "Stratoliners" had just been delivered, the first series of twenty Douglas DC-4s were under construction, and Lockheed had just started building the prototype of its "Constellation."



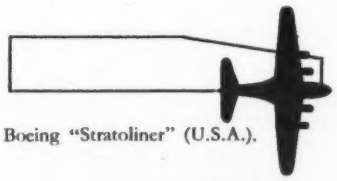

The black silhouettes give an idea of the size and configuration of the aircraft ; their distance from the base line on the left gives, wherever possible, the cruising speed at which the indicated maximum range can be flown (a second, high cruising speed is contained in the table). The relation between range and payload is discernible from the trapezoidal diagram : the latter's greatest height indicates the maximum payload permitted by the available volume (calculated at 170 lbs. per passenger and 10 lbs./cu. ft. cargo space) ; the greatest width of the diagram corresponds to the maximum range in still air, if every drop of fuel which can be carried in the normal tanks, is used up. All data are based on unified assumptions and can, therefore, differ from the official data released by the manufacturers.



"Languedoc 161" (France).

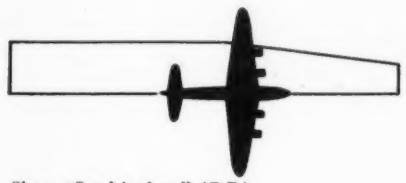


SIAI-Marchetti SM.95 (Italy).

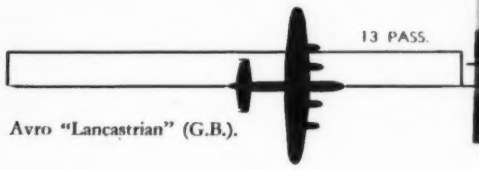


Boeing "Stratoliner" (U.S.A.).

INTER-AVIA



Short "Sandringham" (G.B.).




Avro "Lancastrian" (G.B.).

When hostilities ceased and steps could be taken to develop a world air transport system, the military operations over long distances had already revealed the superiority of this type of aircraft compared with the pre-war equipment, and even shown that overseas services as well as trans-continental routes could very well be flown with land-planes. Sharp competition completed the job of introducing the long-range four-engined commercial transport into every airline company operating inter-continental services.

Thus it will be found that the present compilation of modern four-engined types lists no aircraft that is older than the three standard American types mentioned above. Meanwhile, this should not be construed as meaning that the existing four-engined types are on the average more modern than the twin-engined designs ; for many of them are converted or merely re-fitted bombers, and thus correspond to their present-day field of application still less than if they had been built for this specific purpose ten years ago.

| Country | Manufacturer or Designer | Designation | Power Plant: Manufacturer and Designation | Power Plant: Take-off power | Dimensions: Span | Dimensions: Length | Dimensions: Wing area | No. of seats | Disposable Load: Cargo volume | Disposable Load: Maximum payload [1] | Crew |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | H.P. | ft. in. | ft. in. | sq. ft. | | cu. ft. | lbs. | |
| France | SNCA du Sud-Ouest | 161 "Languedoc" | Pratt & Whitney "Twin Wasp" R-1830-S1C3-G | 1,200 | 96' 5" | 79' 7" | 1,198 | 33 | 353 | 9,140 | 5 |
| Italy | SIAI-Marchetti | SM 95 | P & W "Twin Wasp" R-1830-S1C3-G | 1,200 | 112' 4" | 81' 3" | 1,381 | 38 | ... | 14,606 | 5 |
| U.S.A. | Boeing | 307B "Stratoliner" | Wright "Cyclone 9" GR-1820 | 1,200 | 107' 3" | 74' 4" | 1,486 | 38 | 520 | 11,660 | 5 |
| G.B. | Short | "Sandringham" | Bristol "Pegasus 38" | 980 | 112' 9½" | 86' 3" | 1,687 | 45 | 666 | 11,900 | 7 |
| | | | P & W "Twin Wasp" R-1830/90B | 1,200 | 112' 9½" | 86' 3" | 1,687 | 45 | (4,250 lbs.)[2] | 11,900 | 7 |
| G.B. | A.V. Roe & Co. | "Lancastrian" | Rolls-Royce "Merlin 24" | 1,640 | 102' | 76' 10" | 1,297 | 9<br>13 | 332<br>530 | 4,850<br>7,510 | 5<br>5 |
| G.B. | Handley Page | "Halton" (Halifax VIII) | Bristol "Hercules 100" | 1,675 | 103' 8" | 73' 7" | 1,275 | 10 | ... | 10,500[3] | 5 |
| G.B. | A.V. Roe & Co. | "York" | Rolls-Royce "Merlin 24" | 1,640 | 102' | 78' | 1,297 | 21 | 390 | 7,470 | 5 |
| U.S.A. | Douglas | DC-4 | P &W "Twin Wasp" 2SD13-G | 1,450 | 117' 6" | 93' 5" | 1,457 | 44 | 420 | 11,680 | 5 |
| G.B. | Short | "Solent" | Bristol "Hercules 759" | 2,000 | 112.8' | 88.6' | 1,687 | 40 | (4,750 lbs.)[2] | 11,000 | ... |
| G.B. | A.V. Roe & Co. | "Tudor IV" | Rolls-Royce "Merlin 621" | 1,740 | 120' | 85' 6" | 1,421 | 32 | 384 | 9,280 | 6 |
| Canada | Canadair | C-4 "Canadair Four" | Rolls-Royce "Merlin 624" | 1,760 | 117' 6" | 93' 5" | 1,457 | 40 | 698 | 13,780 | 5 |
| G.B. | Handley Page | "Hermes IV" | Bristol "Hercules 763" | 2,100 | 113' | 97' | 1,408 | 63 | ... | 17,000[3] | ... |
| U.S.A. | Douglas | DC-6 | P & W "Double Wasp" CA 15 (with water injection) | 2,100 (2,400) | 117' 6" | 101' 6" | 1,463 | 52 | 464 | 13,480 | 6 |
| Italy | Breda-Zappata | BZ 308 | Bristol "Centaurus 568" | 2,500 | 137' 9½" | 110' | 2,225 | 55 | 865 | 18,000 | 6 |
| U.S.A. | Lockheed | "Constellation 649" | Wright "Cyclone 18" 749C18BD1 | 2,500 | 123' | 95' 10" | 1,650 | 60 | 440 | 14,600 | 5—6 |
| | | "Constellation 749" (with "Speedpak") | Wright "Cyclone 18" 749C18BD1 | 2,500 | 123' | 95' 10" | 1,650 | 60 | 440 (840) | 14,600 (18,600) | 5—6 |
| U.S.S.R. | S. Ilyushin | IL-18 | A. Schvezov ASch 82 | 1,800 | 131' | 100' | ... | 66 | ... | ... | 6 |
| U.S.S.R. | A.N. Tupolev | TU-70 | M-90 | 2,000 | 141' | 119' | 1,720 | 72 | ... | ... | 5 |
| U.S.A. | Boeing | 377 "Stratocruiser" | P & W "Wasp Major" R-4360 | 3,500 | 141' 3" | 110' 4" | 1,720 | 100 | 900 | 24,500 | 5—7 |
| U.S.A. | Douglas | C-74 "Globemaster" | P & W "Wasp Major" R-4360 | 3,500 | 173' 3" | 124' 1½" | ... | 125 | 615 | 26,400 | 5 |
| France | SNCA du Sud-Est | SE 2010 | P & W "Wasp Major" R-4360 (with water injection) | 3,250 (3,500) | 160' 7" | 130' | 2,536 | 98 | 1,695 | 33,620 | 6 |
| U.S.A. | Martin | JRM-1 "Mars" | Wright "Cyclone 18" R-3360-8 | 2,250 | 200' | 120' 3" | 3,686 | 133 | 4,010[3] | 40,100 | 11 |
| | | JRM-2 "Caroline Mars" | P & W "Wasp Major" R-4360 | 3,000 | 200' | 120' 3" | 3,686 | 133 | 4,010[3] | 40,100 | 11 |
| U.S.A. | Lockheed | R 6 0-1 "Constitution" | P & W "Wasp Major" R-4360 | 3,500 | 189' | 156' | 3,610 | 168<br>92 | 2,000<br>7,300 | 43,400 | 12 |

[1] Calculated uniformly at 170 lbs. per passenger and 10 lbs./cu.ft. cargo space, eventually taking into account maximum permissible landing weight. Weight reduced by empty tanks.

[2] Including crew and oil.

[3] Including radio equipment, moveable equipment and all passenger amenities.

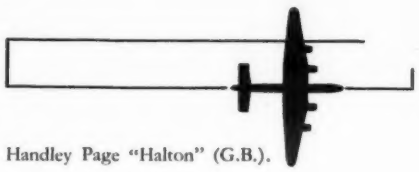
[4] For range (variable with payload), see graphic presentation.

[5] Or minimum take-off length at sea level defined in CAR and ICAO safety regulations.

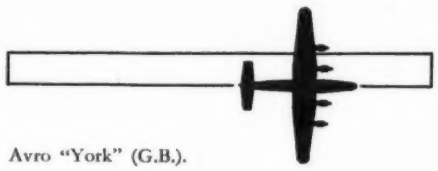
[6] Should not exceed 60 per cent. of available landing run.

As in previous reviews of this series, the four-engined types presented graphically and in the table, are listed in accordance with their take-off weight, in order to facilitate reference and comparison. However, it becomes immediately evident that this yardstick is not an entirely true one, neither for "feeling the size" of an aircraft nor for assessing its performance. The large majority of these aircraft differ much less in their dimensions than they do in their gross weight. Whereas the "Constellation 749" weighs over twice as much as the "Languedoc," the difference in wing area between the two types is only of 40 per cent., so that they are externally similar in size ; and the "Stratocruiser," of which the gross weight is 30 per cent. greater than that of the "Constellation," has not a very much greater wing area than this type.

We are led to believe that the take-off weight is a handy yardstick for assessing the performance of an aircraft, since it is evident that the maximum disposable load — payload, fuel and a few other, less important weight



Handley Page "Halton" (G.B.).



Avro "York" (G.B.).

| Fuel supply | Maximum total [2] | Total Weights: Tare weight [3] | Take-off weight | Landing weight | Wing-loading at take-off | Power-loading at take-off | Economic Cruising Speeds: *a)* High (usually max. on weak mixture) m.p.h. | Altitude | H.P./eng. | *b)* Low (for long ranges) [4] m.p.h. | Altitude | H.P./eng. | Take-off and Landing over 50-ft. obstacle: Take-off distance 4 engines | 3 engines [5] | Landing distance [6] | Service ceiling | Pressure cabin |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Galls. | lbs. | lbs. | lbs. | lbs. | lb./sq. ft. | lb. H.P. | | | | | | | ft. | ft. | ft. | ft. | |
| 1,848 | 18,640 | 32,730 | 51,370 | 51,370 | 43 | 10.7 | 217 | ... | 630 | ... | ... | ... | 2,870 | 4,840 | 3,825 | 19,700 | — |
| 2,138 | 19,860 | 33,050 | 52,910 | 52,910[9] | 38.3 | 11 | 204 | 11,500 | 630 | 198 | 11,500 | 580 | 3,000 | ... | 3,035 | 22,300 | — |
| 1,780* | 19,325 | 34,675 | 54,000 | 47,000 | 36.3 | 11.25 | 215 | 10,000 | 625 | 200 | 10,000 | ... | 3,950 | 4,000 | 2,595 | 19,500 | P |
| 2,032 | ... | ... | 56,000 | ...[10] | 33.2 | 14.3 | 188 | 9,000 | 680 | 176 | 5,000 | ... | 58 sec.[13] | ... | ... | 13,500 | — |
| 2,032 | ... | ... | 60,000 | ...[10] | 35.5 | 12.5 | 206 | 10,250 | 795 | 175 | 5,000 | 600 | 53 sec.[13] | ... | ... | 18,700 | — |
| 3,174<br>2,154 | 27,810<br>25,670 | 37,190<br>36,190 | 65,000<br>61,860 | 58,000<br>58,000 | 50<br>47.6 | 9.9<br>9.4 | 280 | 20,000 | 850 | 210 | 15,000 | 570 | 3,600 | ... | 2,250 | 22,500 | — |
| 2,190 | ... | ... | 65,000 | 55,000 | 51 | 9.7 | 270 | 15,000 | ... | 210 | 15,000 | ... | ... | ... | ... | 21,000 | — |
| 2,478 | 27,137 | 43,863 | 71,000 | 61,000 | 54.7 | 10.8 | 259 | 10,500 | ... | 217 | ... | ... | 5,640 | ... | 3,600 | 23,000 | — |
| 3,601* | 30,427 | 42,573 | 73,000 | 63,500 | 50.1 | 12.4 | 246 | 20,800 | ... | 205 | 10,000 | 720 | 3,900 | *c.* 5,500 | 2,725 | 22,000 | — |
| ... | 29,700 | 48,300 | 78,000 | ... | 46.3 | 9.75 | 251 | 11,500 | 1,305 | 200 | ... | ... | 40 sec.[13] | ... | ... | 17,100 | — |
| ... | 30,775 | 49,225 | 80,000 | 74,000 | 56.3 | 11.5 | 305 | 25,000 | ... | 202 | 10,000 | ... | 5,250 | ... | ... | 26,000 | P |
| 3,220 | 32,800 | 47,400 | 80,200 | 68,000[11] | 55.1 | 11.4 | 333 | 25,800 | 1,165 | 222 | 10,000 | ... | 2,900 | 5,000 | 2,760 | 26,700 | P |
| 3,142 | 27,500 | 54,500 | 82,000 | 75,000 | 58.2 | 9.75 | 298 | 24,000 | ... | 212 | 10,000 | 750 | 4,200 | ... | 3,480 | 24,900 | P |
| 4,248* | 37,746 | 55,454 | 93,200 | 78,000[12] | 63.7 | 11.1<br>(9.7) | 313 | 20,400 | 1,175 | 231 | 10,000 | ... | ... | 5,830<br>(5,110) | 3,030 | 25,000 | P |
| 4,121 | 44,100 | 59,525 | 103,625 | 88,185 | 46.5 | 10.35 | 289 | ... | 1,625 | 217 | ... | ... | ... | 4,600 | 2,365 | 26,250 | P |
| 4,690* | 35,900 | 58,100 | 94,000 | 84,500 | 57 | 9.4 | 313 | 20,000 | 1,400 | 267 | 20,000 | ... | 3,060 | 4,200 | 2,800 | 25,700 | P |
| 5,820* | 46,000<br>(44,100) | 59,000<br>(60,900) | 105,000 | 89,500 | 63.7 | 10.5 | 323 | 23,000 | 1,400 | 267 | 20,000 | ... | 3,850 | 5,200 | 3,000 | 23,800 | P |
| ... | ... | ... | ... | ... | ... | ... | 225 | ... | ... | 170 | ... | ... | ... | ... | ... | ... | ? |
| ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ? |
| 7,715* | ... | ... | 135,000 | 121,700 | 78.5 | 9.65 | 340 | 25,000 | 1,900 | 300 | ... | ... | 4,000 | 5,500 | 3,860 | 30,000 | P |
| 11,000* | 69,288 | 85,712 | 155,000 | 127,500 | ... | 11.1 | ... | ... | ... | 300 | 19,700 | ... | ... | ... | ... | ... | P |
| 7,700 | 60,400 | 97,200 | 157,600 | ... | 62.1 | 12.1<br>(11.25) | ... | ... | ... | 280 | ... | 1,600 | 5,900 | ... | 4,920 | ... | P |
| 13,220* | 66,000 | 79,000 | 145,000 | ... | 39.4 | 16.1 | ... | ... | ... | 152 | ... | ... | ... | ... | ... | ... | — |
| 13,220* | 83,739 | 81,261 | 165,000 | ... | 44.8 | 13.75 | ... | ... | ... | 173 | ... | ... | ... | ... | ... | ... | — |
| 10,000* | 69,425 | 114,575 | 184,000 | 160,000 | 51 | 13.2 | ... | ... | ... | 286 | ... | ... | 4,320 | ... | 2,300 | 27,600 | P |

[2] Manufacturers indications which cannot be analysed further.

[3] Total available volume including passenger cabin: this value is the basis of present payload computation.

[9] With empty tanks only 49,600 lbs.

[10] With empty tanks only 47,500 lbs.

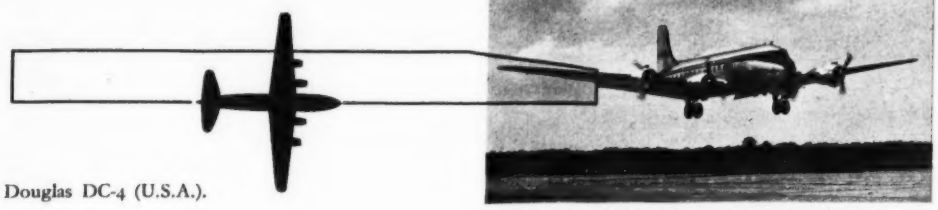
[11] With empty tanks only 63,000 lbs.

[12] With empty tanks only 72,000 lbs.

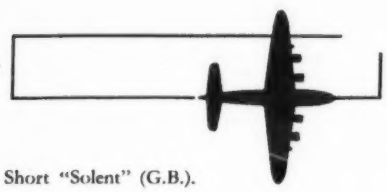
[13] Until airborne.

* U.S. Gallons.

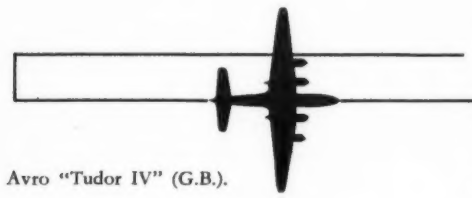
data — is an almost fixed portion of the take-off weight. Nevertheless, let us for a moment consider the diagrams pertaining to each aircraft type, which show the range towards the right, and upwards the negotiable payload for each range. It will be seen that the upper limiting line of the diagram slopes down to the right (*i.e.* if it slopes at all) only in the domain of long ranges, and therefore that the maximum payload decreases, in accordance with fuel requirements, in this domain only. In the case of smaller ranges, the limited capacity of the fuselage is opposed by an increase in the payload (horizontal part of the line), and larger ranges cannot be attained because the tanks preclude the carriage of more fuel (vertical limit on the right). The possibility of increasing the payload or range by increasing the take-off weight is therefore restricted by these two limits. This change in permissible take-off weight can fully affect the payload and range only in the region where the upper line of the diagram slopes to the right, thus where neither the capacity of the fuselage nor that of the fuel tanks is fully exploited.



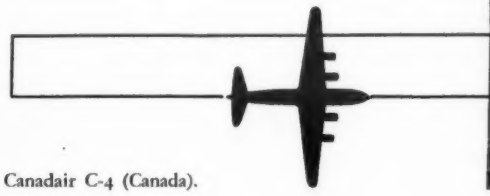
Douglas DC-4 (U.S.A.).



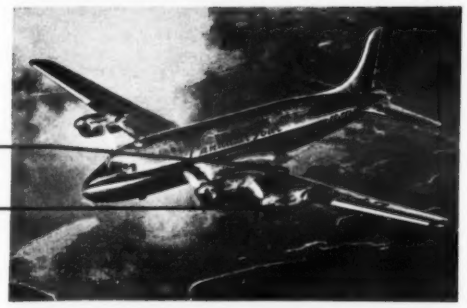
Short "Solent" (G.B.).

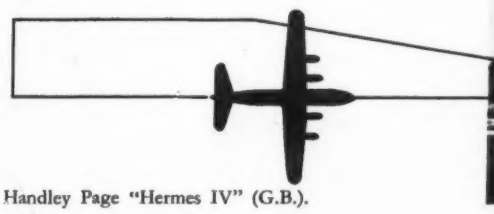


Avro "Tudor IV" (G.B.).



Canadair C-4 (Canada).





Handley Page "Hermes IV" (G.B.).

In converted bombers the fuselage is frequently so narrow that no more passengers and cargo can be carried over short distances than on long-range flights with the fuel tanks full (cf. the low, rectangular diagrams pertaining to the "Lancastrian" for 13 and the "York" for 21 passengers). In the case of these aircraft, therefore, the permissible take-off weight has no influence on the payload.

But even in many aircraft specifically designed for civil aviation, the sloping part of the diagram is only short. If an aircraft has been planned sufficiently ahead, and it possesses the necessary strength, it is frequently possible, in the course of the years, to increase the permissible take-off weight by fitting more powerful or more suitable engines, improving the take-off and landing characteristics, reinforcing the weakest components (notably the undercarriage), and so forth. In this case there is an increase in the maximum disposable load of the aircraft, thus either the payload or the fuel supply, according to desire, with which it can take off ; the sloping section of the payload line then moves upwards or to the right, and continues to shorten. Ultimately a state is reached in which the disposable load can no longer be increased other than by increasing the size of the fuselage so that it can cope with an increase payload, or by fitting a new wing and larger fuel tanks so as to enable the range to be improved.

This is clear from the diagrams pertaining to the Lockheed "Constellation," of which the take-off weight of 94,000 lbs. for the Model 649 has been increased to 105,000 lbs. in the Model 749 (the sloping part of the line rises), the range improved by the larger fuel tanks of the Model 749's wing (diagram extended towards the right), and the fuselage capacity increased by adding the detachable "Speedpak" cargo container (horizontal part of the line rises). Thanks to other, more radical modifications, the Douglas DC-4 gave birth to the "Canadair Four" and the DC-6, which likewise have larger maximum payloads and ranges, but give rise to less strongly sloping diagrams than the original aircraft.

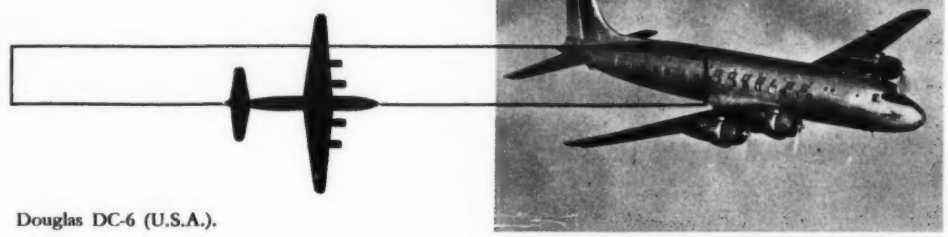
Military transport versions have been or are being built of some of the commercial transports listed here : the C-54 "Skymaster" from the Douglas DC-4, the "Hastings" (with tail-wheel undercarriage) from the Handley-Page "Hermes", the C-69 and lately the C-121 from the "Constellation," and the C-97 from the Boeing "Stratocruiser." In addition, there are other four-engined transport aircraft of the U.S. Air Force and Navy from which peaceful commercial versions may at some time or other be developed : the Douglas C-47 "Globemaster," sometimes timidly called the DC-7 ; the old Martin "Mars" flying-boat and its newest civilian counterpart, the "Caroline Mars" with more

powerful engines ; and finally the Lockheed "Constitution" landplane.

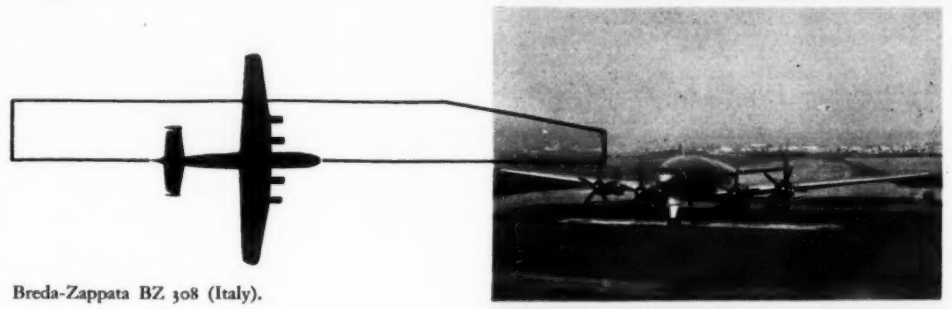
It might be asked whether a military transport aircraft differs to a great extent from a commercial airliner. As a matter of fact, it differs considerably more than is generally assumed. It must be realised that the commercial transport has to fly a definite route network and at the same time respect rigid safety regulations ; the military transport, on the other hand, must be ready for all types of operations, sometimes involving extremely long distances, and the conditions can be such that it is absolutely necessary to risk a take-off with an excessive load. This is clear from the accompanying diagrams : their form approaches that of a triangle. This means that the fuselage is sufficiently spacious to take on a relatively high payload during flights over short distances, still abiding by the usual standards ; if the need arises, however, no heed will be taken of these standards and the fuselage will be stuffed with just about everything it can contain. In other words, the horizontal line to the diagram will be sent packing, the sloping one will be continued up to the left-hand edge and brutally kicked upstairs if circumstances make it necessary. The fact that the diagram runs to a point at the right-hand edge simply means that the tanks are large enough to hold all the fuel that the aircraft can lift when taking off for a long-distance flight without payload.

The three examples given here — converted bombers, continuously improving commercial airliners, and finally military transport aircraft — show the importance of fuselage capacity for the performance. The natural question is whether this could not be used as a yard-stick. In this connection it may be recalled that neither in merchant shipping is it the practice to indicate the weight of the ship, *i.e.* its displacement. The expression "register ton" is misleading. A "register ton" is not a measure of weight, but signifies 100 cubic feet of hold volume, whereby a further difference must be made between gross register tons, which denote the entire hold volume plus all closed-in superstructures, and net register tons, signifying the volume available for passengers and goods, thus minus allowances for machinery, crew quarters, etc.

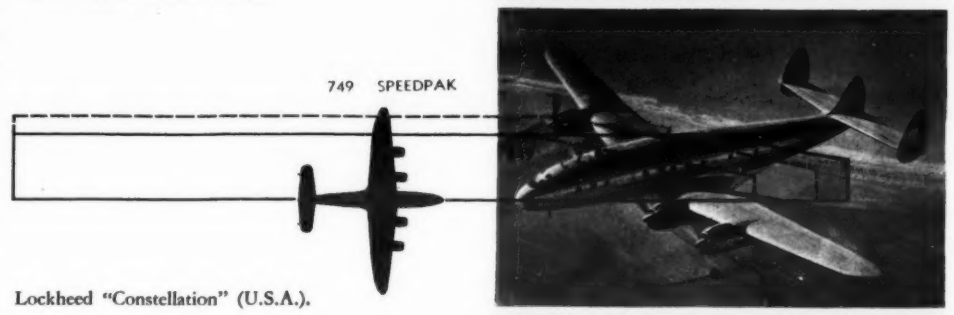
Unfortunately there are not sufficient data available on the aircraft mentioned here for us to order them according to gross or net register tons. We have therefore confined ourselves to calculating the "capacity payload" according to standards of the Air Transport Association of America (170 lbs. payload per passenger seat and 10 lbs. for every cubic foot of cargo volume ; cf. third column under heading "disposable load" in the table, and maximum payload in the diagrams). These values cause the aircraft types to come in the following order.



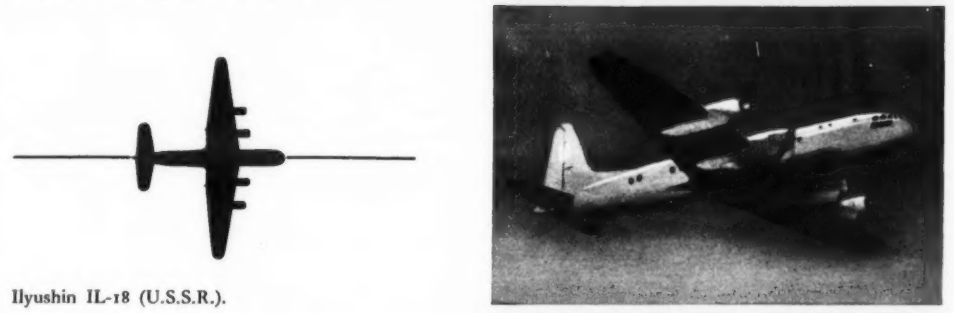
Douglas DC-6 (U.S.A.).



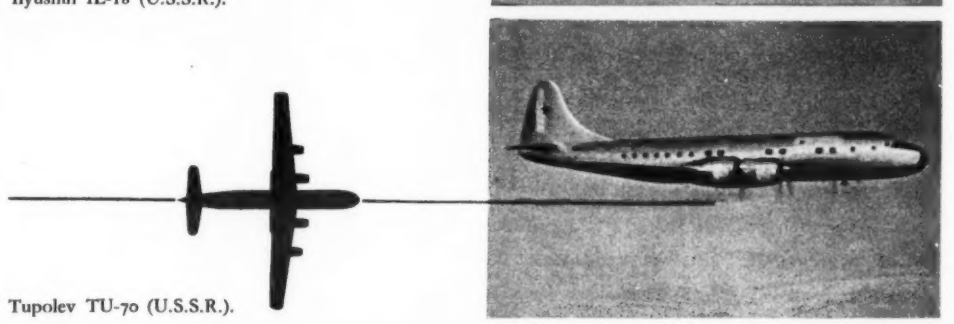
Breda-Zappata BZ 308 (Italy).



Lockheed "Constellation" (U.S.A.).



Ilyushin IL-18 (U.S.S.R.).



Tupolev TU-70 (U.S.S.R.).

Of all the aircraft at the beginning of the table, which externally are of approximately the same size, the "*Lancastrian*," a civilian conversion from the Avro "Lancaster," has the smallest fuselage capacity. In the nine-passenger version, large fuel tanks are contained in the former bomb bay ; in the thirteen-passenger model, this space is used for cargo, though no great increase in payload is achieved by this. The "*York*," which has the same wing and power plant, has a more spacious fuselage, accommodating 21 passengers, but less cargo space and consequently a capacity which is almost the same as that of the thirteen-seater "Lancastrian."

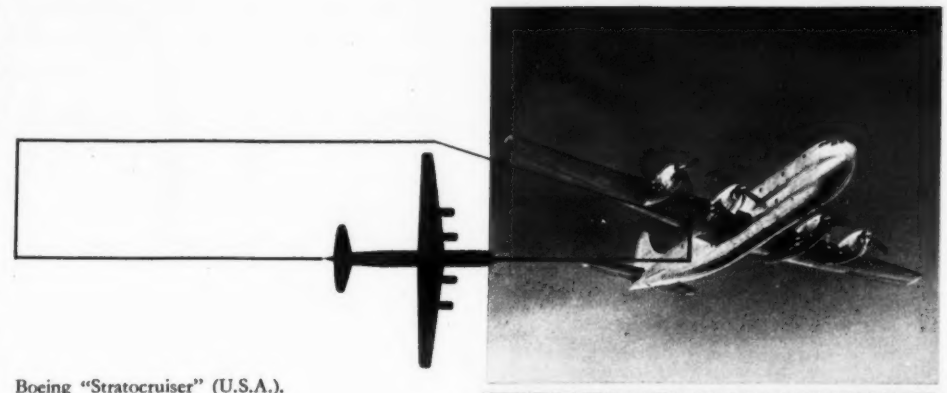
Next comes the French "*Languedoc*," although it is the smallest aircraft of the series as regards wing area and gross weight. It is followed by the "*Tudor IV*," which is in a way a modern replacement for the "York." In the "Tudor" series it was planned to suit the fuselage dimensions to the specific payload desired by each customer, instead of initially providing a more than large enough standard fuselage and dividing it up and equipping it according to requirements. But the touchy

story of the 41-passenger "Tudor II" reveals how difficult it is for the designer to tell the customer where to stop, in order that his desires may remain compatible with good flight performance. The "Tudor IV" belongs among the smaller versions of this series, all of which have wing dimensions and power plant characteristics to cope with even greater payloads.

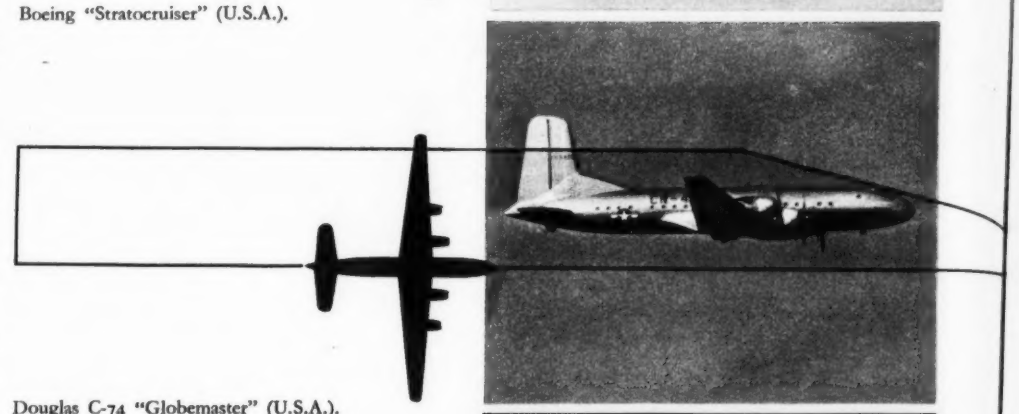
When the Handley Page "Halifax" bomber was converted into the stop-gap "*Halton*" airliner, the cargo volume was increased by placing a container beneath the fuselage. Though no data on the actual cargo volume are available, it seems that this has stepped up the payload to a useful level.

Aircraft with maximum payloads of around 12,000 lbs. follow next : the British *Short* "*Sandringham*" and "*Solent*" flying-boats — whose capacity seems to be limited rather by constructional than space considerations ; then the *Boeing* "*Stratoliner*," the *Douglas DC-4* and its *DC-6* and "*Canadair-Four*" derivations. Oddly enough we can place the *SIAI-Marchetti SM.95* here, since a relatively very high payload can be calculated for it. This is due to two reasons, first because the 38 passengers are confined to a narrower space than in specific long-range airliners, and secondly because of its relatively large cargo volume, since even in the case of normal loading density, the cargo compartments always take on more payload per unit of volume than the passenger cabins do. It seems that the picture is thereby distorted, that the standards are based on the number of passengers instead of on the volume of the cabins.

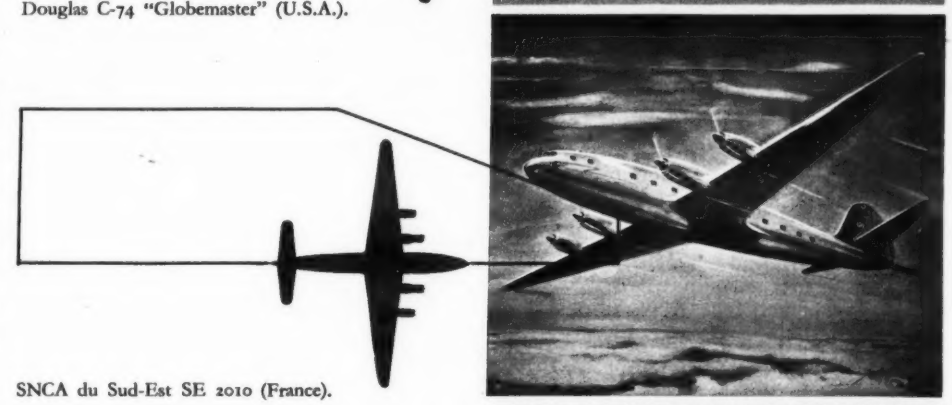
We have already outlined the development of the *Lockheed* "*Constellation*." According to data so far released on the Handley Page "Hermes IV" and the Breda Zappata BZ 308, both prototypes of which made their first flights only recently, the payloads of these two aircraft would seem to be approximately between those of the "Constellation" with and without "Speedpak" detachable cargo container. Though very few details are available concerning the Russian *Ilyushin IL-18* and *Tupolev TU-70* transports, they nevertheless seem to come into this size category. And for the remaining types, the order in which they come according to capacity payload coincides with that in the table. Meanwhile, special attention is drawn to the diagram relative to the Boeing "*Stratocruiser*" : it reveals that its take-off weight of 135,000 lbs. places a noticeable restriction on the payload during long-range operations, and therefore that this aircraft may, in the next few years, feature a considerably higher performance than it does today. *T.*



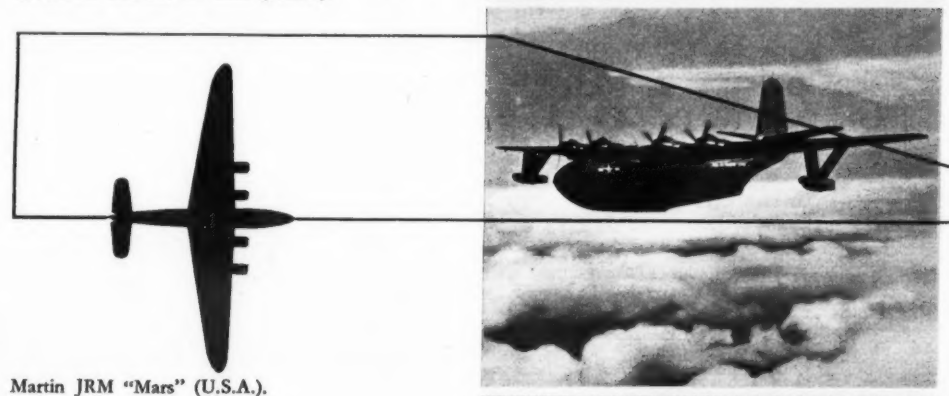
Boeing "Stratocruiser" (U.S.A.).



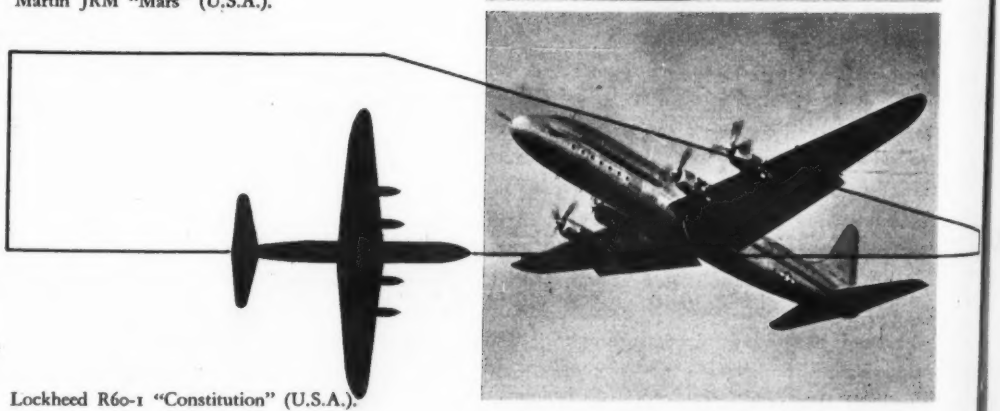
Douglas C-74 "Globemaster" (U.S.A.).



SNCA du Sud-Est SE 2010 (France).



Martin JRM "Mars" (U.S.A.).



Lockheed R6o-1 "Constitution" (U.S.A.).

# Sponsoring Iceland's Air Navigation Facilities

The Arctic, supremely important to military aviation, is also a focal point of interest to civil airline operators. The Icelandic Government declared itself unable to establish and maintain on Iceland, the air navigation facilities essential to world civil aviation, without financial aid. Sponsors were soon found. On June 8th, 1948, on the occasion of the Second Assembly of the International Civil Aviation Organisation, in Geneva, ten countries whose airlines fly the North Atlantic, agreed to finance these installations jointly. Thus on September 16th, 1948, an agreement was signed in Montreal between ICAO and the Government of Iceland. In oder to defray expenses from 1946 up to December 31st, 1948, Iceland receives Kr. 7,500,000. For the period from 1949 onwards, the ten contracting nations (Belgium, Canada, Denmark, France, Iceland, Netherlands, Norway, Sweden, United Kingdom, United States) guarantee an annual contribution of up to Kr. 4,225,000.

The accompanying photo shows the agreement being signed at ICAO's Montreal headquarters.

Left to right (front row) : Rear Admiral P. A. Smith, U.S. Representative on the ICAO Council ; Mr. Agnar Kofoed-Hansen, Director of the Iceland Aeronautics Board ; Dr. Edward P. Warner, President of the ICAO Council ; Dr. Albert Roper, ICAO Secretary-General ; and Dr. F.H. Copes van Hasselt, Netherlands Representative on the ICAO Council.

Back row : Mr. C. M. Colbeck, U. K. Alternate Representative on the ICAO Council ; Dr. T. F. Reis, Brazilian Representative ; Lieutenant Colonel Jean Verhaegen, Belgian Representative ; Dr. K. N. E. Bradfield, Australian Representative ; M. Henri Bouché, French Representative ; Mr. C. S. Booth, Canadian Representative ; Mr. G. Hultstrom, Swedish Representative ; and Mr. A. R. McComb, ICAO Deputy Secretary-General.

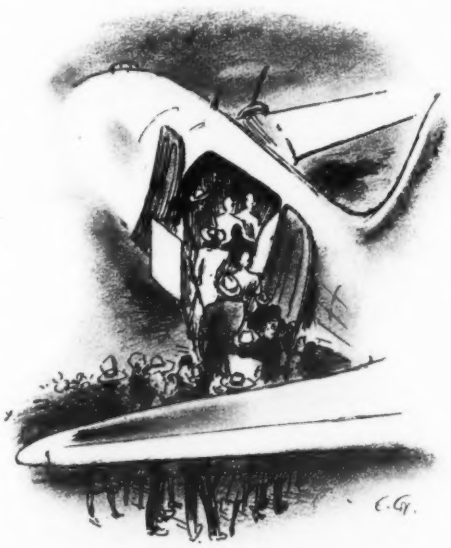
# *U. S. Air Force Day in Germany*

Thousands of Germans streamed through the airfield gates at Frankfurt and Wiesbaden. It was September 18th, 1948, U.S. Air Force Day, and Germans were authorised to visit the American air bases.

In Frankfurt alone, 15,000 people were counted, who, from early in the morning until late in the afternoon, wanted to have a close look at the Berlin air-lift operations.

The young generation could not withhold its enthusiasm, and a number of eager youngsters were even allowed to scramble inside the belly of a big four-engined B-17. Grown-ups were content to have a look at a less agressive Dakota, and a patient queue filed one by one into the twin-engined cargo version, carefully noting every interior detail.

Fifteen thousand Germans did not divert a stolid American sergeant from his paternal duties ; due to travel in that plane, he calmly continued giving his four-month-old baby its bottle. A twenty-year-old negress, fresh from Munich and wearing a genuine Bavarian Dirndl as gracefully as if she had been born there, looked thoroughly bored by the whole procedure.



"THE NATION OF AVIATORS" has to queue up...

Some timid souls lost their enthusiasm for flying as they speculatively examined the contents of a rubber rescue dinghy -- from the fishing rod to the waterproof bibles for Protestants, Catholics, and Jews. Said one : "Time-tables for travelling into the next world . . ."

Frankfurt's housewives simply could not get over the fact that five-year-old "trans-Atlantic tots" already spoke American.

The plea of a pretty young thing, complete with new look, into the ear of a British pilot — "Won't you take me with you ?" — was drowned by the engine roar of a Belgian aircraft. She stayed behind and was seen a little later on the arm of a young man with whom she apparently couldn't agree on where they should fly to, if . . . *J. F.*

The S.B.A.C. flag flutters proudly in front of Sir Roy Dobson's presidential tent.

# The 1948 S.B.A.C. Display in Retrospect

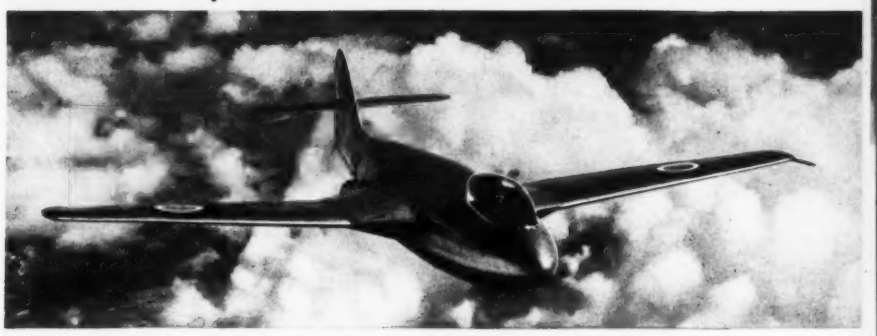
It needs courage to organise a national aeronautical exhibition every twelve months and invite experts from all over the world to visit it. Right after the war it was much easier for the Society of British Aircraft Constructors. At that time it was able to unveil to the public products which had been on the secret list during the war and were mostly only known from hearsay.

With regard to the Ninth S.B.A.C. Display, held from September 7th to 11th, 1948, at Farnborough (it is a pity that Radlett had to be abandoned as exhibition site), a no less important person than the Minister of Supply himself, Mr. G. R. Strauss, remarked that the British Aircraft manufacturing industry was this time able, despite the long development periods required for aircraft and engines, to put on show over forty aircraft of all types, which had never before been exhibited at an S.B.A.C. Display. It is indeed astonishing that the S.B.A.C. member companies were able to put up such a fine performance at Farnborough in the face of difficulties of all kinds. True, a number of the most interesting aircraft were exhibition items, concerning which practically no operational data are available and some of which have not yet effected their first flights, or only carried them out a day or two before the exhibition started. But it is simultaneously a convincing proof of the self-confidence of the designers and engineers, who had the courage to exhibit before over 5,000 critical visitors from all parts of the world, aircraft in flight which had previously been subjected to no real flight testing. The four-engined Handley Page "Hermes IV" airliner, powered with Bristol "Hercules 763" twin-row radials of 2,100 H. P., which accommodates forty passengers and is awaited with impatience by British Overseas Airways Corporation, took to the air for the first time on September 5th, 1948, thus only two days before the exhibition started. And the Avro "Tudor VIII" jet airliner, with four Rolls-Royce "Nene" turbo-jets, did not even fly until September 6th.

It is understandable that the S.B.A.C. is using every means to parry the complaints to which the British aircraft manufacturing industry has been subjected recently. The advance of American competitors in commercial transport aircraft construction, unclarified accidents involving British equipment, and the difficulties met by the national airline corporations in acquiring material in their own country, has given rise to much unpleasant criticism in the ranks of the British

At the 1948 S.B.A.C. Display at Farnborough, about 70 aircraft were spread over the field for visitors to inspect.

The EXPERIMENTAL AVRO "TUDOR VIII" transport aircraft, powered with four Rolls-Royce "Nene" turbo-jets, coming in to land at Farnborough.



Hawker Aircraft Ltd. showed their new P. 1040 JET FIGHTER (Rolls-Royce "Nene").

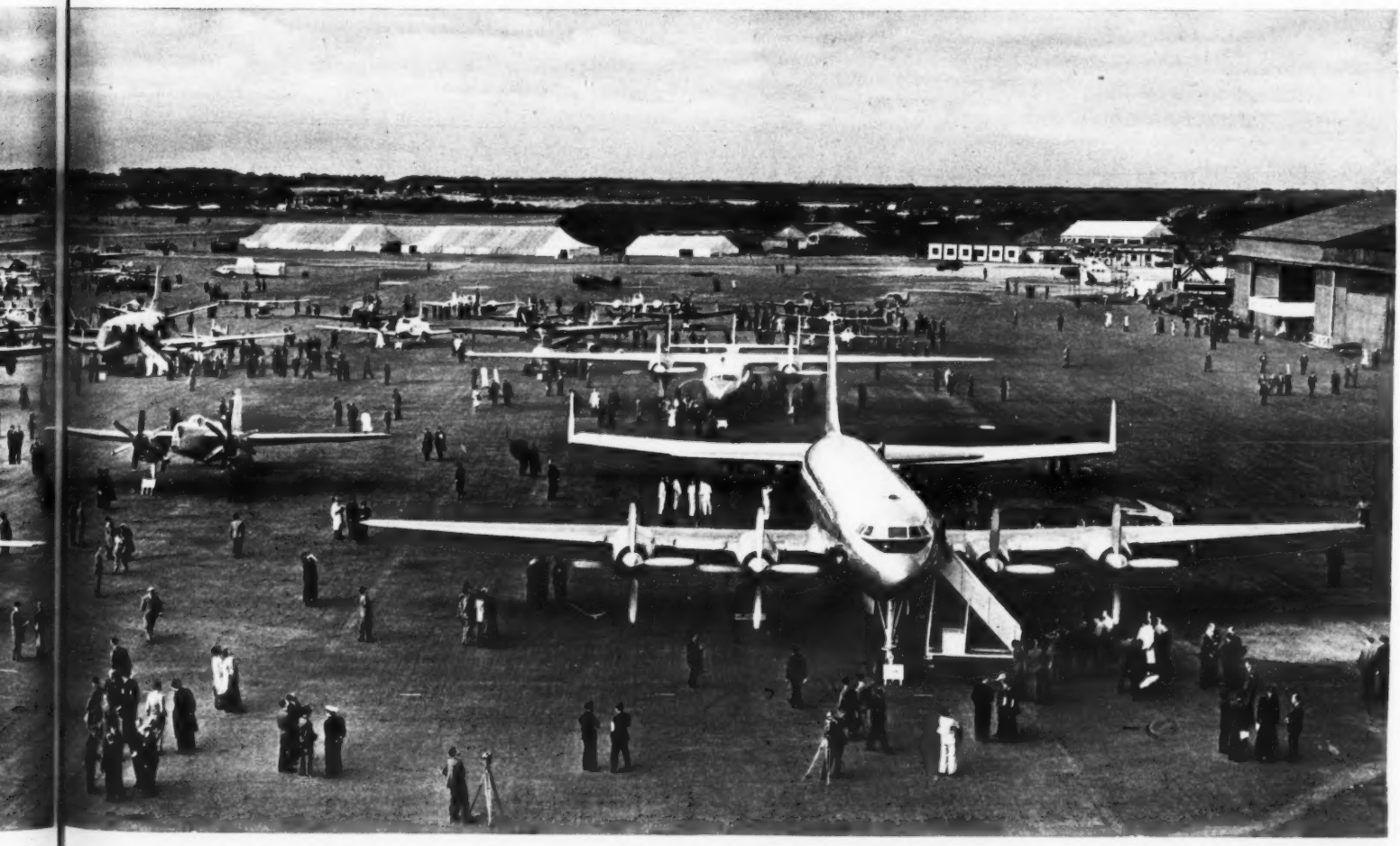
taxpayers. It is therefore not astonishing that the last available "commercial transport aircraft," be it a flying test stand, a pure research aircraft or a prototype, was compelled to attend the Farnborough show.

Two months have already elapsed since the S.B.A.C. Display. It would therefore not be profitable for us to start now going into the technical details of the aircraft, engines and accessories which were on show. Nevertheless, the general impression which the foreign visitor gained from the event can be just as informative as a compilation of details.

Compared with earlier S.B.A.C. Displays, the 1948 one featured a noticeable change. No longer did the gas-turbine engines constitute the focal point of interest in the exhibition building, but rather their application on the airfield. Meanwhile, it would certainly be wrong to deduce from this that engine research is proceeding less intensively than beforehand (no Englishman ever gives up a stronghold without a fight); but these efforts seem to have become obscured by the fact that England's advance in engine design is now having its practical effect on transport aircraft construction. Turbine aircraft are not built in one day and put into airline service the next. But Great Britain today possesses the tools with which she can gain the requisite experience for the practical application of these power plants.

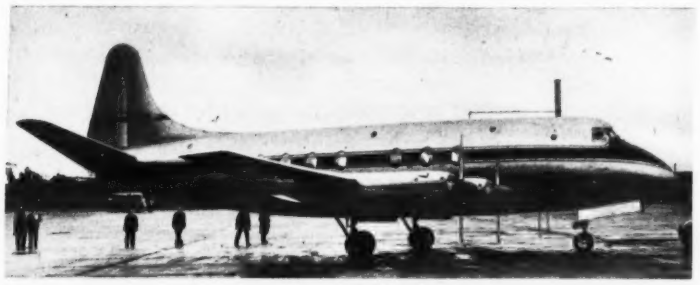
It is well known that English fighter aircraft are well at the top of the class. Although no unknown types made an appearance at Farnborough, except for the new Hawker P. 1040 single-seater fighter and its N.7/46 carrier-borne counterpart, the flight demonstrations of the "Vampire," "Meteor" and D.H.108 nevertheless proved this judgment to be correct. That the masterly demonstration of the Saro SR/A1 jet fighter flying-boat will certainly remain unforgettable for every visitor and possibly give many a military expert something to think about, is just mentioned *en passant*.

However, all this failed to conceal a noticeable gap. There was not a single modern bomber on show at Farnborough in 1948. Is it the presence of American B-29 heavy bombers (which modestly call themselves medium-heavy) in England, or is it the almost exclusive use of American flying equipment for the supply flights to Berlin, or else the present political uncertainty, which makes this gap appear particularly disquietening to Central Europeans ?



The second prototype of the **AIRSPEED "AMBASSADOR"** twin-engined airliner, due to replace B.O.A.C.'s Vickers "Vikings," made an excellent impression during its flight demonstration.

The new **HANDLEY PAGE "HERMES IV" AIRLINER,** fitted with four Bristol "Hercules" twin-row radials of 2,100 H.P., did not make its first flight until two days before the show started.



The **VICKERS "VISCOUNT" EXPERIMENTAL TRANSPORT,** equipped with four Rolls-Royce "Dart" propeller-turbines, attracted a great deal of interest.

It was certainly not by mere chance that the distinguished engineer and British jet pioneer, *Air Commodore Sir Frank Whittle,* acceded to a request of the International Air Transport Association and, a few days after the Farnborough show, addressed IATA members in Brussels on the possibilities of applying gas turbines to civil air transport.

Even though Sir Frank was not able to go beyond the secrecy regulations of his country, which are today very strict again, he nevertheless succeeded in arousing in his listeners that measure of interest which is an indispensable prerequisite to the introduction of turbine power plants in civil aviation. He is convinced that the numerous advantages of the gas turbine—its low specific weight, small dimensions, relative freedom from vibration, mechanical simplicity and therefore a high degree of reliability accompanied by low maintenance costs, and so forth—make it an ideal means of propulsion for civil transport aircraft. It is specially interesting to note that Sir Frank stresses the possibility of using explosion-proof fuel as one of the major advantages of the gas turbine. It is his opinion that "the fear of being burnt alive in a minor crash keeps more people away from air travel than anything else."

"...in no case should a gas turbine take anything like as long as a piston engine to develop," stated the distinguished pioneer. "I have no doubt that ultimately the cost per unit power in quantity production will be less than half that of a reciprocating engine," are his encouraging words. His view on the applicability of turbines to civil aviation is straight to the point : "...there is no reason why the propeller gas turbine should not be introduced into civil airlines within the next five years" ; but he continues more cautiously with the words "...it seems likely that the jet airliner may have to await radical improvements in methods of airport control."

Whether he wanted to or not, Sir Frank Whittle pointed to the weakest point in the organisation of civil aviation. Directly after the cessation of hostilities there existed engines which already then would have allowed sonic speeds to be reached. At that time, however, there existed no airframes capable of standing up to such stresses. Today, a very similar situation is arising : high speed commercial transports driven by jet propulsion cannot be put into operation because their high fuel consumption at low altitude renders unbearable the time loss incurred by present all-weather approach methods.

Much has been written about the awkward conditions and sometimes exceptionally long waiting periods at airports having to cope with dense airline traffic. Up to the present day, however, no method has been found to enable airport control personnel to bring in, without any delay, all approaching aircraft with perfect safety. It seems as though a radical conversion and a far-reaching automatisation of the entire airway and airport traffic control system must take place before this goal can be really approached.

You may ask upon what fundaments such an automatic traffic control system would have to be based. The answer is not complicated, and it is contained in the extensive preparations made in this respect in America. [1] A new system of controlling the air space is inconceivable without radar and the improved modern television methods.

The achievements of Sir Frank Whittle and the British aero-engine industry are recognised throughout the world. Meanwhile, however, Great Britain possesses a second savant, without whom the Battle of Britain might have taken another course : *Sir Robert Watson-Watt,* pioneer in the practical application of radar. Without his far-sightedness, England would never have been in the position to watch over, already at the beginning of the war, her air space by means of a complete radar warning system erected along her coasts. Long before the outbreak of war Sir Robert laid the foundation stone of certain research and industrial activities, which were kept secret a long time, and of which the results were later made available to the United States of America. It would be an error to seek the birthplace of radar in any country other than Great Britain.

It is not without intention that we are coupling this retrospect of the 1948 S.B.A.C. Display with the names of Sir Frank Whittle and Sir Robert Watson-Watt. The first created the aircraft prime mover of the future. Will the second give civil aviation what it needs most urgently today—a practical airport control system ?

Air Commodore **SIR FRANK WHITTLE** addresses the IATA Annual Meeting in Brussels. On the extreme right can be seen Sir William P. Hildred, IATA Director-General ; on the extreme left is M. Gilbert Périer, IATA President and Managing-Director of Sabena.

[1] Cf. "Interavia, Review of World Aviation," Vol. III, No. 7, pp. 366-368.

## Social Conflicts in the French Aeronautical Industry

# The Serious Problem of the SNECMA Aero-Engine Firm

The incidents, strikes and social conflicts which arose in two of the principal branches of French aeronautics during September are not connected in any way.

In reality, the strike which paralysed Air France services, first at Le Bourget airport, then at Orly, and later at Toulouse and Marseilles, was a wage strike declared by the ground personnel, and was a part of the large movement organised by the unions. It was just one of the many demands for higher wages, and represents no serious underlying danger as far as French aviation is concerned.

Meanwhile, however, the strike which broke out on Wednesday, September 15th, at different factories of the Société Nationale d'Etudes et de Construction de Moteurs d'Aviation (SNECMA) was quite another matter and infinitely more serious. It will be recalled that it was marked by serious street fighting and a miniature battle between SNECMA workers and the police force, right in the middle of Paris.

There is no doubt that the origins of these incidents touch on the very existence and future of France's principal aero-engine firm. Indeed, it seems that no solution to this complex can be found which does not need force.

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Before going into the details of the precise causes of the SNECMA incident, let us first examine the sequence of the events of September 15th as they were related to us by various eye-witnesses.

Workers at the Issy-les-Moulineaux plant of the old Société Voisin, a company of which the majority of shares is held by SNECMA, have been engaged for several months on the perfection and line production of a tractor engine destined to power a vehicle built by the Société des Manufactures d'Armes, of Paris. This engine, which is particularly intricate in design, does not seem to have given entire satisfaction to customers and, after various incidents, the Société des Manufactures d'Armes felt obliged to cancel its production contract with SNECMA. In consequence, SNECMA's Issy-les-Moulineaux plant risked finding itself without work from one day to the other, and the management therefore let it be known that, in accordance with a plan for general re-organisation, which we shall discuss later on, a large number of workers would have to be dismissed.

In the face of this state of affairs, the various unions represented in SNECMA formed a delegation and decided to demand a hearing from the Managing Director and the special Government administrator, Henri Potez, during the morning of Wednesday, September 15th.

The intention was to protest against any attempt at mass dismissals, for whatever reason they may be ordered, in any of the various factories working for SNECMA. To endow their protests with the necessary power, they decided that all workers would down their tools during the day of the 15th, and that all should march down together to the Company's head office at 150, Boulevard Haussmann, Paris.

For its part, the SNECMA management was willing to receive the delegation and to talk matters over.

Up to that moment, therefore, everything proceeded according to plan and in an orderly fashion. By request of the SNECMA management, no police guard was placed around the head office.

However, whilst the delegation was waiting inside the building for the management to receive it, the mass of workers grouped along the Boulevard Haussmann manifested their discontent rather noisily, just as a few American cars were driving by. The police force was alerted and entered into action in an attempt to disperse the crowd. The result was exactly what was to be expected : there was a general fight, and after the usual regrettable incidents, the police remained masters of the situation.

So far, therefore, the events seem to have occurred in much the same fashion as in all manifestations of a social character — with the usual sequence of blows, broken heads, shouts and insults. They would not merit more than a few lines of print if it were not that the whole complex happened to have concealed a crucial problem, one concerning the future of 14,000 SNECMA workers and even the future of the entire company.

*

As regards the general problem of nationalisation, which quite a few Frenchmen have been dealing with for some months, SNECMA occupies a very special position. It will perhaps be recalled that the SNECMA concern was already discussed in an official report of March 25th, 1947 ; this was the report on the situation of the nationalised companies, made by Messrs. Pellenc and Chalandon. It may furthermore be remembered that SNECMA's affairs worsened to such a point that in June, 1948, the French National Assembly, after learning of the horrifying financial losses suffered by this firm, asked the Government Financial Commission to look into the company's affairs and to elaborate a law endowing it with a

Workers demonstrate in front of the SNECMA head office at 150, Boulevard Haussmann, Paris.

Editée par le Comité d'Entreprise et le Comité mixte à la Production
SNECMA
..MAIS IL DOIT SAVOIR
QU'ETROITEMENT
UNIS LES TRAVAILLEURS DE LA S.N.E.C.M.A. S'OPPOSERONT
A TOUT LICENCIEMENT
et que les ouvriers, les techniciens et les cadres
CONTINUERONT A SE BATTRE POUR LEUR DROIT A LA VIE

The SNECMA workers' house magazine states : ". . . it is only by closely standing together that SNECMA workers can defend themselves against dismissals. Workers, technicians and office staff will continue to fight for their rights of existence. . ."

provisional status preparatory to a general re-organisation of SNECMA.

SNECMA, born the day after the Liberation, grouped together the former Société Gnome et Rhône, the old Société Nationale de Construction des Moteurs Lorraine, and various general engineering factories. Later on, it increased its number of employees by adding those of the former Société des Moteurs Renault. It could thus boast a payroll of 15,000 ; and on August 28th, 1948, Air Minister Tillon, who had dismissed the members of the board of the Société Gnome et Rhône, appointed as President and Managing Director, Mr. Marcel Weill, an engineer from France's famous Ecole Polytechnique and one of Mr. Tillon's closest assistants.

In this way SNECMA was faced with the important problem of establishing an equilibrium between a large staff of workers and the various possibilities of production open to the firm.

It is appropriate to emphasise here two important factors which helped to render SNECMA's problem still more difficult. First of all, this production was not uniform, since SNECMA was constructing, in its different factories, parts and accessories for old German and French aero engines, engines for tractors, bicycles, motor cycles, artillery shells, and so forth ; it had its own foundries and produced its own materials. In addition, the majority of these factories had suffered under the Occupation and the bombing attacks, and everything had to be re-organised, re-equipped, and to some extent re-built.

Finally, it is well known that building aircraft engines is one of the most delicate and tedious engineering undertakings.

In view of the means at its disposal, SNECMA could therefore not hope to attain any really satisfactory commercial results for quite a few years. In the meantime, provisional solutions were applied in an attempt to balance a budget gradually deteriorating under the strain of paying out regular wages to 15,000 workers.

It might be profitable rapidly to underline one of the difficulties incurred by the nationalisation of the aircraft factories. The State, which in the particular case of SNECMA was at once the supplier and the customer, repeatedly attempted to justify its two points of view by re-arranging its interests. In its rôle of supplier, it had to concern itself with the enormous financial needs of the concern, satisfy the latter's claims, and improve on its means of production ; as a customer, on the other hand, its duty was to negotiate for the lowest possible purchase prices. The Air Minister, presiding over these two operations, was therefore constantly torn between two conflicting interests.

Mr. Henri Potez, the administrator appointed by the Government to re-organise SNECMA.

It was precisely this situation which recently resulted in the retirement of Mr. Weill as President and Managing Director, and the appointment, by request of the Government, of a person who had proved his ability to run a big industrial undertaking, Mr. Henri Potez. In order to become economically sound, SNECMA was faced with the necessity of dismissing a large section of its workers and abandoning many of the factories not working directly for aviation. It would be reformed as a company strictly concerned with aeronautics ; the cast-off branches should indulge in activities completely independent of SNECMA.

It was proposed that the SNECMA payroll be reduced from 15,000 to about 8,000 workers.

*

The acuteness of SNECMA's social problem therefore becomes most evident. Mr. Henri Potez, who is charged by the Government to complete his re-organisation plan within six months, finds himself wedged between the duty of placing the concern on a sound economic basis in accordance with the means at his disposal, and the desire not to dismiss brutally and without compensation thousands of workers and engineers whose skill and goodwill is acknowledged throughout France. No definite solution is envisaged so far.

In the words of the Government : "France would be resigning her rights as an air power if she abandoned the construction of French aircraft engines." Hence SNECMA must continue to live—live with the means of producing engines befitting the skill of its engineers. However, the concern may not continue to waste energy and money on dispersed production plans which are of no commercial value. As crucial as the problem is, the Government can nevertheless not remain oblivious to the fate of some 6,000 workers who are in no way responsible for this state of affairs.

Unfortunately, the incidents of September 15th did not give rise to any solution. But a solution must be found. In the interest of the French aeronautical industry, therefore, it is to be hoped that this solution will be found very soon.

*G. F.*

Official Bulletin of the

FÉDÉRATION AÉRONAUTIQUE INTERNATIONALE, PARIS

Minutes of a Meeting of the F.A.I. Gliding Commission, held at Samedan on 27th July, 1948.
Samedan, on 27th July, 1948.

Represented were :
Belgium : Mr. W. Grandjean.
Denmark : Mr. Per Weishaupt.
Egypt : Mr. H. S. Kamil.
France : Mr. R. Jarland, Mr. R. Cartier.
Netherlands : Mr. L. A. de Lange.
Spain : Mr. J. Ordovas Gonzales.
Sweden : Captain L. Bunke.
Switzerland : Mr. A. Hug, Mr. A. Gehriger.
United Kingdom : Mr. D. G. O. Hiscox.
United States : Captain J. J. Ide.

1. *Election to Office :*

The President, Mr. P. A. Wills, handed in his resignation.

The Commission elected the following :
President : Mr. P. Massenet (France).
Vice-Presidents : Mr. A. Gehriger (Switzerland) and Mr. P. A. Wills (G.B.).

2. *The following new catagories of soaring records and controlled performance were adopted :*

*a)* Absolute altitude record.
*b)* Speed record over a triangular course of 100 kms.
*c)* Speed competitions over courses of 100, 200, 300, 400 and 500 kms., with established goal.

3. *Proposal of the National Aeronautic Association of America :*

The Commission adopted the proposal that Class D. machines (sailplanes) should not have to return to the point of departure in attempts on the duration record. This is based on the reasoning that changes of a meteorological nature could sometimes lead a pilot to carry out his trials over other ground than that of his point of departure.

4. *Maximum release altitude in record attempts :*

The Commission decided that the condition providing that, when sailplanes are launched with the aid of tug aircraft, "the separation should occur at least at 1,500 metres above the point where the sailplane left the ground," is to be declared void, in order not to preclude wave flight. It is up to the responsible commissioner to take steps to register the exact point and time of release, either by boarding the tug or another aircraft.

5. *International Soaring Competition of the F.A.I. in 1949 :*

At the London Meeting of the Commission, in 1946, it was decided that an International Soaring Competition of the F.A.I. would only take place every other year. It is the opinion of the Commission that this condition should be upheld and that the next F.A.I. Competition should take place in 1950. In the meantime, this does not prevent countries from organising international soaring competitions, but these shall not come under the patronage of the F.A.I.

The Swedish delegate informed those present that the Swedish Aero Club will celebrate its fiftieth anniversary in 1950 ; since aeronautical exhibitions and displays are foreseen for this occasion, it might be possible to include this Soaring Competition in the programme.

The F.A.I. decided on this question during the General Conference in Paris.

6. *Soaring at the 1952 Olympic Games :*

The Commission thanked the Finnish Aero Club for its intention to do everything in its power in order that soaring may be included in the 1952 Games, and is in entire agreement on this matter.

The Commission recommended that the International Olympic Committee should be approached in order that pilots selected by each national Olympic committee may be allowed to compete.

The Commission decided that pilots should not be forced all to use the same type of sailplane, the question of luck playing a considerable rôle in soaring competitions. In any case, the characteristics of these aircraft call for a fairly flexible code of regulations.

The Commission asked the Finnish Aero Club to co-operate with the French Aero Club and draft these regulations.

7. *Relations between the F.A.I. Gliding Commission and the organisation destined to succeed ISTUS :*

The Commission is willing that this organisation should adopt the name "Organisation Scientifique et Technique Internationale du Vol sans Moteur (OSTIV)" and rules that this organisation should settle the financial aspects at its own meetings.

8. *Report on the Competitions held at Samedan — Observations to be derived therefrom :*

This report has already been drawn up by the Swiss Aero Club.

9. *Miscellaneous questions :*

*Licences for private sailplane pilots.* ICAO, at its meeting in April, 1948, drew up a regulation in this connection, which will come into force in 1949. The wishes of the F.A.I. were taken into account when drafting this regulation.

The Commission has no objections to raise against the paragraphs relative to age, qualifications and experience.

With regard to the paragraph relative to "skill," however, the Commission suggests that each nation should define the trials which come under this heading. The F.A.I. shall submit this suggestion to ICAO.

The question is asked as to whether the soaring hours could not be counted, at any rate in part, in the 30 annual hours required for the renewal of the A licence of an aeroplane pilot. A compensation could be made by not counting hour for hour, but, for example, two hours of gliding for one hour in an aeroplane, such as is already the custom in certain countries.

*The following new record has been homologated by the F.A.I. :*

Classe C (aeroplanes).
*Altitude* (United Kingdom).
Pilot : Group Captain John Cunningham, D.S.O., D.F.C.
Aircraft : de Havilland D.H. 100 "Vampire" Mark I, T.G. 278.
Power plant : de Havilland "Ghost" 2/2 turbo-jet of 4,299.99 lbs. thrust.
Hatfield, Herts, 23rd March, 1948 : *18,119 metres.*

# Book Reviews

*The Atomic Problem.* By James M. Spaight. — Published by Arthur Barron Ltd., London, 1948.

Atomic energy and its rôle in future wars is a theme which is apt to arouse the fantasy of authors and their readers to a high pitch. However, it is a domain where nothing could be more dangerous than fantasy. Spaight avoids it. With praiseworthy thoroughness and patience, this distinguished English authority on air law has gathered together the requisite historical, political and social data so as to present the problem in a clear and unambiguous manner. Is there a means of outlawing the atomic bomb ? Unfortunately not for the present. Even if the Geneva Protocol of 1925, which prohibits the use of poison gas in warfare, were applied to this menace, the U.S.A., sole possessor of large stocks of atomic bombs, would not be prevented from using it since the U.S.A. is not a party to the Protocol. The first step suggested, therefore, is U.S. adherence to it, supplemented by a new clause prohibiting atomic warfare. The second step is the establishment of really effective international control over all atomic production—a concept severely opposed by Russia. For the interim period, Spaight suggests sanctions against an atomic war wager.

This small brochure (54 pages) is a welcome supplement to Spaight's very complete "Air Power and War Rights" (Cf. "Interavia Review" Vol. II, No. 11). It contains nothing sensationally new, but presents an essential and reliable foundation upon which we can conduct our moral battle against atomic warfare.

*He.*

*La Aeronautica Nacional al Servicio del Pais.* — Published by the Argentine Secretariat for Air, 1948.

Alexandre Dumas relates in his memoirs that when he retired in 1830 from Paris to Le Havre in order to write his tragedy on Charles VII and his vassals, he travelled for twenty-four hours—fourteen hours by postchaise to Rouen and ten hours by mail-boat. Add another ten hours, and you can travel from New York to Rome nowadays. What would Magellan's stalwarts, who sailed the River Solis (now La Plata) in 1520, have said to the prophecy that one day the Montevideo-Spain trip would require only thirty-four hours ?

The leaders of the young Argentine nation were quick to recognise the revolutionary significance of aviation to the development of their politics and commerce. "To rule, you have to populate" was the slogan of the Nineteenth Century statesmen in Argentina. "Aviation means prosperity," declare the men now responsible for the destiny of the nation. And we are forced to share this conviction when we look at the truly magnificent book recently published by the Argentine Secretariat for Air. The story of Argentine aviation is depicted in all its glory in 345 large-size pages, starting with the deeds of the national pioneers—Fels, Newbury, Zuloaga, Bradley, Parodi, Zanni—extending to the Atlantic flight last year by 72 Air Force cadets, their three aircraft proudly bearing the names of Christopher Columbus' caravels in symbolic honour and gratitude to the mother-country, Spain. Richly and artistically illustrated with engravings, photographs and impressive coloured diagrams, it describes in full the organisation of Argentine aviation, airports, pilot training, aircraft manufacturing, and so forth. National pride, but also true international thinking, are evidenced in the preface by General Bartolomé de la Colina, the Argentine Secretary for Air. (Spanish)

*Pl.*

# THE MONTH IN REVIEW

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## *AVIATION POLITICS*

● A Franco-Spanish civil aviation agreement concluded on August 23rd provides for the following regular routes : Paris—Madrid, Paris—Barcelona, Barcelona—Toulouse (with intermediate landings), Bilbao—Bordeaux, Valencia—Algiers—Oran. The Spanish Iberia airline proposes to use Dakar as an intermediate landing point on its South Atlantic service.

● China has notified the Soviet Government that she desires to terminate the ten-year Sino-Russian civil aviation agreement which was concluded in 1939. It would appear that the denunciation of the agreement aims to stop the Sino-Soviet Hamiata airline service over the Sinkiang Province. Previous to this, the Chinese Government had already banned all foreign aircraft, except Russian ones, from flying over the western part of Sinkiang.

● Civil air talks between Great Britain and Denmark, preparatory to the conclusion of a civil aviation agreement, started in London on September 28th.

## *FIRST FLIGHTS*

● The Avro "Tudor VIII" four-engined airliner powered with Rolls-Royce "Nene" turbo-jets made its first flight on September 6th, when it flew from the Avro factory airfield at Woodford, Cheshire, to the Aircraft and Armament Experimental Station, at Boscombe Down.

● The prototype of the SE 1010 four-engined survey aircraft made its first flight recently. SNCA du Sud-Est is building a small series of ten of these aircraft for the Institut Géographique National.

● The SE 1210, flying test model of the SE 1200 flying-boat being developed by SNCA du Sud-Est, is now undergoing its flight tests. An initial version of the SE 1200 will be powered with four pairs of Arsenal 24 H liquid-cooled 24-cylinder in-line engines of 4,000 H.P. for take-off, and a second version will have eight propeller-turbines. The SE 1210 test model has four Renault 6Q air-cooled six-cylinder in-lines of 240 H.P. take-off power.

● The Breda-Zappata BZ 308 four-engined airliner made its first flight on August 27th. In view of the inadequate size of the Sesto San Giovanni airfield, Breda plans to carry out future flight testing at Capodichino, Naples, or Amendola, Foggia.

● The Saab J-29 single-jet fighter made its first flight on September 1st over the factory airfield of Svenska Aeroplan A.B. at Linköping. The first three prototypes will be powered with British de Havilland "Ghost" turbo-jets ; production models will have "Ghost" engines built under licence by Svenska Flygmotor A.B.

SE 1010.

● Karhu-48 is the designation of a new four-seater strut-braced high-wing monoplane developed by Veljekset Karhumäki O/Y, of Halli, Finland, which recently made its first flight. Built entirely of wood, it has as power plant a 190-H.P. Lycoming o-435 air-cooled flat-six driving an Aeromatic propeller.

## *NEW AIRCRAFT*

● The Lockheed XF-90 high-speed fighter is designed as a penetration fighter. Power is supplied by two Westinghouse J-34 turbo-jets of at least 33,000 lbs. thrust, and two 1,000-lb. rockets for short-period power boosts. The XF-90 should be able to attain 600 m.p.h. on its turbo-jets alone, and it is expected that the rockets will boost this to supersonic level.

● The Republic XF-91 high-speed fighter is specially designed for interceptor fighter operations at altitudes up to 50,000 feet. Its power plant will probably consist of a more powerful version of the General Electric-Allison J-35 turbo-jet, which will deliver about 5,600 lbs. static thrust with water injection. Alternative power plant may be a General Electric J-47 (TG-190) turbo-jet of 5,000 lbs. thrust. The XF-91 will also have four Reaction Motors Inc. rockets, each developing 800 lbs. thrust, to enable the aircraft to climb rapidly to its optimum operating altitude. A maximum speed of over 700 m.p.h. is anticipated.

● The prototype of the Convair XF-92 high-speed fighter is being readied for its flight test at Muroc Air Force Base, Calif. Power plant of this prototype comprises merely one Westinghouse turbo-jet of unspecified type. Production aircraft will have an additional power plant comprising a battery of nitromethane rockets furnishing an additional thrust of 13,000 lbs. Production aircraft are expected to be able to attain a maximum speed of over 800 m.p.h. using the turbo-jet and rockets ; endurance will be about 30 minutes.

● The Bell XH-15 is a new two-seater helicopter, designed for liaison work, which Bell Aircraft Corp. is now flight-testing. The U.S. Air Force has ordered three experimental models. Power is supplied by a Continental XO-470 engine of 270 H.P. Rotor diameter is 36 feet 10 ins., length 43 ft. and gross weight 2,700 lbs. Its maximum speed is over 100 m.p.h.

● The Widerøe C-5, a Norwegian single-engined high-wing monoplane of composite wood and metal construction, has been granted its type certificate. Designed by Birger Hønningstad, the aircraft was built by Widerøe's Flyveselskap at Oslo-Fornebu. The C-5 may be used as a personal and light transport aircraft for six occupants, for ambulance or for air survey work. It may be fitted with a wheel undercarriage, skis or Edo floats. Power plant may be either a 320-H.P. Wright R-760-E2 "Whirlwind" seven-cylinder radial or a 450-H.P. Pratt & Whitney R-985 "Wasp Junior" nine-cyclinder radial.

Widerøe-Hønningstad C-5

● The I. Ae. 31 "Colibri" two-seater trainer manufactured by Argentina's Instituto Aerotecnico de Cordoba, which has a 155-H.P. Blackburn "Cirrus Minor III" air-cooled four-cylinder in-line, attains a maximum speed of 140 m.p.h., a cruising speed of 127 m.p.h., and has a landing speed of 47 m.p.h.

## *POWER PLANTS*

● The Rolls-Royce "Avon" turbo-jet was shown to the public for the first time when two of these engines were installed in place of the two outboard engines of an Avro "Lancastrian" at the S.B.A.C. Display. A more powerful development of the Rolls-Royce "Nene," it differs from the latter by having an axial compressor ; it is understood to produce over 6,000 lbs. thrust.

● The 75-H.P. Régnier 4J four-cylinder in-line engine built by the Société Nationale d'Etudes et de Construction de Moteurs d'Aviation (SNECMA), has received its approved type certificate. Tests for the latter were carried out in accordance with ICAO standards.

## *RESEARCH*

● A new supersonic wind tunnel capable of speeds up to 1,700 m.p.h. is approaching completion at the NACA Langley Memorial Aeronautical Laboratory, Hampton, Virginia. It has a test section of 4 ft. × 4 ft. and will be used chiefly for testing models of supersonic aircraft. Special refrigeration equipment installed

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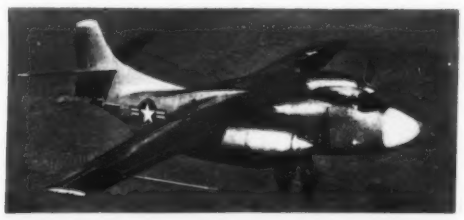

North American XAJ-1 carrier-borne bomber, shown fitted with two Pratt & Whitney "Wasp Major" radials and one General Electric (Allison) turbo-jet built into the rear fuselage.

* Excerpts from Nos. 1515-1537 ("August 20th to September 22nd, 1948) of "Interavia Air Letter," an aeronautical digest published five times weekly, with photo service, in separate English and French editions.

just ahead of the test section will enable the anticipated tunnel temperature of 230 deg. F. to be reduced to about 100 deg. F. Two other NACA supersonic tunnels are being prepared for operation : one at the Ames Aeronautical Laboratory, Moffet Field, Calif., has a test section measuring 6 ft. × 6 ft. and is for speeds up to 1,200 m.p.h. ; the second one, at the Flight Propulsion Laboratory, Cleveland, Ohio, has a test section of 8 ft. × 6½ ft. and is designed for speeds up to 1,350 m.p.h.

### *AIR TRANSPORTATION*

● INTERCONTINENTAL : KLM Royal Dutch Airlines opened an Amsterdam—Shanghai service with Lockheed "Constellations" on September 28th. The new route is being flown once weekly. On the basis of an agreement with Northwest Airlines, KLM can now offer round-the-world trips, with KLM flying the New York—Amsterdam—Shanghai run, and Northwest the Shanghai—New York Pacific flight. The fare for the trip is £425.

● Australian National Airways has comprehensive plans to increase migrant traffic between Europe and Australia. Two Douglas DC-4s have already been purchased for this purpose, and at least seven more will be chartered. In addition to its already existent service for transporting 600 Europeans monthly to Australia, ANA will make 12 and later 20 trips monthly under contract to the International Refugee Organisation. According to H.F. Walsh, General Manager of ANA, Australia will gain at least $1,000,000 annually from the IRO contract.

● A Lockheed "Constellation" of Panair do Brasil landed at Kloten Airport, Zurich, on September 6th, having inaugurated the Brazilian company's new Rio de Janeiro—Recife—Dakar—Lisbon—Zurich service. Operations will be fortnightly to begin with, and later weekly.

● The recently formed Transportes Aereos de Honduras (TAH) has already effected Tegucigalpa—Rome proving flights with two Douglas DC-4s.

● British South American Airways has introduced return fare reductions on its routes to Bermuda and the Caribbean : London—Havana now costs £196.2.0., against £226.16.0.

● KLM Royal Dutch Airlines' most profitable route in 1947 was the Amsterdam—Batavia line with an income of Fl. 34,500,000 (1946 : Fl. 26,000,000). Receipts for other services were : European network, Fl. 18,200,000 ; North Atlantic, Fl. 18,100,000 ; West Indies, Fl. 9,800,000 ; South Atlantic, Fl. 8,500,000 ; and South Africa, Fl. 3,600,000.

● NORTH ATLANTIC : Trans-Atlantic 30- or 60-day winter excursion return fares have been announced by all trans-Atlantic operators except BOAC and TCA (which will probably follow shortly). Typical tariffs are those of American Overseas Airlines and Pan American Airways, who offer New York—London 60-day return tickets between October 1st and April 1st for $466.70, against the normal $630.

● Trans World Airline inaugurated a weekly all-sleeper luxury service between New York and Paris, known as the "Paris Sky Chief," on October 1st. The Lockheed L-749 "Constellations" flying this service have nine sections with space for eighteen berths, each berth being eventually allotted to two passengers.

● Air France now operates three sleeper services weekly between Paris and New York. The French carrier plans to fly scheduled services between France and Canada, and already carried out a proving flight from Paris to Montreal, via Shannon, at the end of July.

● Inauguration of an Italian Rome—New York service cannot be realised immediately, according to a decision by the Special Committee of the Ministry of Defence charged with the allocation of the route. The committee laid down that the first prerequisite will be the unification of the several Italian airlines now operating to foreign countries, and stated that only a Government-backed airline, modelled on the Argentine or British organisations, would be acceptable.

● U.S.A. : According to James C. Buckley, Port of New York Authority Director of Airport Development, the present level of 25,000 to 30,000 trans-Atlantic and trans-Pacific passengers monthly will increase to 100,000 or more within the next ten years.

● Pan American World Airways now offers three round-the-world trips weekly. Prior to introduction of the winter schedules on October 15th, two such trips were flown. PAA's daily New York—London service is now flown non-stop.

● Trans World Airline, United Air Lines, Western Air Lines, Inland Air Lines, Northwest Airlines and Eastern Air Lines increased their passenger fares by 10 per cent. at the beginning of September. This is the third fare increase since April, 1947, and now works out at 6 ½ cents per mile, as compared with a previous 4 ½ cents.

● Pan American-Grace Airways (Panagra) celebrated its 20th Anniversary on September 13th. Since the line's first scheduled flight—from Lima to Talara, Peru—in 1928, Panagra has flown over 640,000,000 passenger miles and carried 715,830 passengers. Its present route network of 9,000 miles serves eight Latin American countries : Panama, Colombia, Ecuador, Peru, Bolivia, Brazil, Chile and Argentina. By arrangement with PAA, Panagra Douglas DC-6s fly to Miami, providing the fastest direct service between Argentina and the United States. The company is 50 per cent. owned by Pan American Airways Corp. and 50 per cent. by W. R. Grace & Co., the U. S. shipping concern with widespread interests in Pacific-Coast South American countries.

● MISCELLANEOUS : Executive aircraft are used by about 800 U. S. business firms and total over a thousand.

● At a CAB-airline conference last August, it was revealed that in 1947 the lines had spent some $11,000,000 on free meals to their passengers ; this figure represents about one half of their total operating loss of $20,900,000.

● Civil aviation has reached such a high level of safety that, according to IATA Director-General Sir William P. Hildred "... you must fly 21,184,000 miles before you can reasonably expect to be killed."

● The management of Airone, the Italian airline based at Cagliari, Sardinia, suggests the operation of glider trains consisting of a powered tug and several cargo gliders, and claims that this method would permit competition on an equal footing with surface transportation media.

● Specially-equipped hospital aircraft are now being operated by the Soviet Ministry of Public Health. The Ukraine Division of the Air Ambulance Service now has 20 transport aircraft fitted with X-ray equipment for the purpose of carrying out systematic medical examination of the population of the Ukraine. Other aircraft carry opthalmic apparatus for examining local inhabitants. The long-established fleet of ambulance aircraft has now been supplemented with flying operating theatres.

● The first Swiss helicopter mail flight was made at Zurich on September 23rd, when a helicopter made trial flights between the city's main post office and the airports of Kloten and Dubendorf.

### *CIVIL AVIATION APPOINTMENT*

● Fernand Hederer has been appointed Secretary General for Civil and Commercial Aviation in the French Government. He succeeds Max Hymans, who has been elected Chairman of the Board of Directors of Air France.

### *SERVICE AVIATION*

● American bombers will be based in Great Britain for at least ten years, according to a U.S. Air Force statement in Washington.

● According to a British Air Ministry statement of September 16th, jet bomber production is to be accelerated in order that entire squadrons may be in operation soon.

● The Brazilian aeronautical school, which corresponds to the U.S. Naval Academy, sends an annual quota of forty graduated aviation cadets to the United States for training at the U.S. Naval Air station at Pensacola, Fla. Argentine and Mexican cadets are also being trained there.

● The laying of field telephone wires by helicopter has been successfully tested by the U.S. Army Signals Corps engineering laboratories.

● The U. S. Navy is re-activating a number of small vessels, including the 11,000-ton light-armoured aircraft carrier "Cabot." The latter will bring the number of U.S. Navy aircraft carriers on active service to 22.

### *SPORTING FLYING*

● A new world speed record of 670.98 m.p.h. was established by Major Richard L. Johnson, of the U.S. Air Force, in a North American F-86 jet fighter at Muroc Air Force Base, Calif., on September 15th. The new record is still subject to confirmation by the F.A.I.

● A new international distance record for aircraft with a cylinder capacity of under two litres was set up on September 11th by a 20-year-old French airwoman, Miss Jeannette Poujade. Piloting a Starck A.S. 70 monoplane, she flew from Lyons-Bron to Skeppsholmen, Stockholm, a distance of over 1,200 miles, in the day. If confirmed, the flight will beat the present record of 1,124 miles set up on August 2nd, 1939, by Heinz Gabler, a German who flew an Erla 5D from Friedrichshafen to Vannaes, Sweden.

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*ERRATUM :*

On page 515 of the September issue of this magazine, it was stated that Germans can pay their passage in German Marks on the B.E.A. route from Hamburg to London. British European Airways Corp. have kindly pointed out that such payment in German Marks only applies to their service between Berlin and Hamburg.

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*PHOTO CREDITS :*

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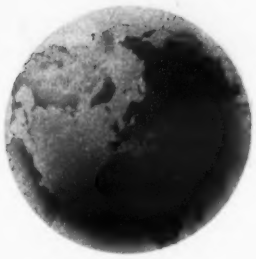

# Marginal Notes

## U. S. S. R. Severs Negotiations and Tightens Berlin Blockade

On September 26th, the head of the Soviet UNO Delegation accused the Western Powers of aggressive intentions. Among other things, he complained about intensive armament by the Anglo-Saxon countries and the staging of joint aerial manoeuvres over Great Britain. The tone and contents of Vishinsky's remarks made it easy to prophesy Russia's intention to break off the Berlin negotiations, which was in fact carried out one day later, on September 27th. The Russian Note, published by the "Tass" agency, insists on the Russian right to control all transportation by air of goods and persons between Berlin and the Western Zones of Occupation — *i. e.* of the Berlin air-lift. By way of reply, the Western Powers placed the entire matter in the hands of the U.N. Security Council.

Following this, Russia announced semi-officially that she would hold anti-aircraft defence manoeuvres in the region of the Allied air corridor leading to Berlin.

## U. S. Air Force Faces the Future

September 18th, 1948, was U.S. Air Force Day, marking the first anniversary of the U.S. Air Force as an autonomous branch of America's armed forces ; it was simultaneously the 41st anniversary of U.S. adoption of the aeroplane as a weapon of war. The U.S. Air Force is faced with great organisational and practical tasks, the heaviest since the end of World War II : among others, realisation of the 70-Group programme, establishment and development of new U.S. air bases in Great Britain, operation of the Berlin air-lift. In order to fulfil these duties, it has been deemed necessary to switch around certain high commanding officers. Lieutenant-General Curtis E. LeMay has been appointed Commander of the USAF's Strategic Air Command. During the war he commanded the 20th Air Force, which operated strategic B-29 "Superfortress" formations chiefly in the Far East. His last post was that of Commanding General of the U.S. Air Force in Europe. On Air Force Day he declared that the U.S. Air Force would do its utmost to set new records in winter on the Berlin supply run. A record was indeed set up on that day by the Anglo-Saxon operators, with 897 flights, 653 by the Americans and 244 by the British.

General LeMay's European appointment has been taken over by Lieutenant-General John J. Cannon, formerly Commander of the Air Training Command.

The former Commander of Strategic Air Command, General George C. Kenney, has been appointed Commander of the Air University at Maxwell Air Force Base, Alabama. USAF Commanders from all theatres have been called to a conference at the Maxwell Air University for the first week in October. Such meetings are organised from time to time to keep overseas commanders posted on latest developments in high policy.

## British Commons on Air Defence

On the occasion of a defence debate at the end of September in the British House of Commons, A. V. Alexander, Minister of Defence, and E. Shinwell, Secretary of State for War, made known the general lines of the new armament programme. Army, Navy and Air Force reserves are to be reinforced considerably. A new mobilisation plan is to provide for a quick-call up of officers and men released since the end of the war. Military and civilian defences of the mother country are to be strengthened considerably. It is expected that pay increases and improved conditions will induce more people to join the regular Army. This applies to all three branches of the armed services.

For the Royal Air Force, the Defence Minister announces the enlistment on a voluntary basis of men and women with previous experience in warfare. Releases due for the last half of 1948 will leave the R.A.F. very short in certain branches. The Minister declared that, for the Auxiliary Air Force and the R.A.F. Volunteer Reserve alone, 60,000 volunteers are necessary. The shortage of manpower is equally alarming in the Royal Observer Corps and all active units of the R. A. F.

Lieutenant-General Curtis E. LeMay, Commander of Strategic Air Command, U. S. Air Force. (Photo taken in 1946.)

Meanwhile, the lack of equipment readiness has also given rise to worry in many quarters. The "Daily Mail," for instance, comments on the fact that the Defence Minister gave no reassurance on Britain's night fighter position.

This discrepancy was also evidenced on the occasion of the British air manoeuvres at the beginning of last September. The aeronautical weekly, "Flight," in its editorial of September 16th, says :

> "An example of the difficulty the fighters found in making contact was afforded on the last night of the Exercises in the only big piece of clear sky which presented itself throughout the period. That night in Norfolk, the searchlights illuminated 23 aircraft ; and the fighters intercepted seven of them."

In its issue of September 9th, "Flight" is even more critical on the subject of heavy bombers :

> "But one can hardly fail to notice that through Government policy and not due to any inability of firms to produce what is required, but a single type represents the heavy bomber in the Royal Air Force. Good as is the Avro "Lincoln," it was designed for the German war . . ."

The Opposition made a sharp attack on the Government's Defence Policy. Group Captain Max Aitken, Lord Beaverbrook's son and, as a former Battle of Britain pilot, representing the general opinion reigning in wide R.A.F. officer circles, maintained that the first-line strength of the R.A.F. fighters was only half what it was at the time of the Battle of Britain. Anthony Eden charged the Government with excessive secrecy ; and O. Lyttleton (Con. Aldershot) declared :

> "In terms of the Army or the Air Force, if the nation knew how many operational units or formations were available west of Berlin, they would confirm a remark I made at some previous occasion — that the Ministry of Defence is a monument of incompetence and extravagance."

However, sharp criticisms in Parliaments, notably in Britain, should not be taken all too seriously. The British Government may recall that a Member once went so far as to tell Disraeli that he was "two-faced."

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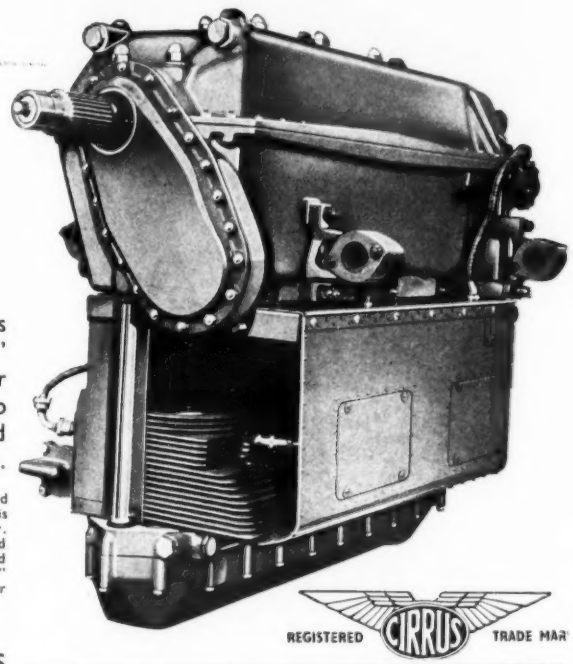

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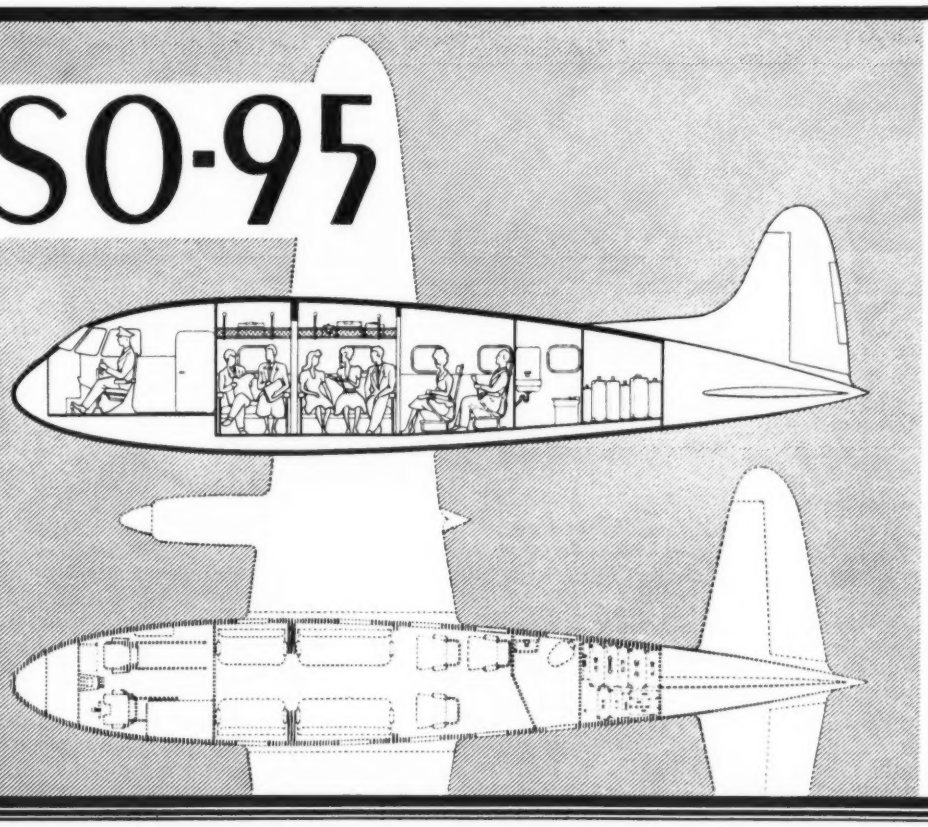

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The first aircraft of the series are now on the point of completing their final flight testing, and will be put into service by the end of the year. One of these aircraft won the International Rally at Cannes in May, 1948.

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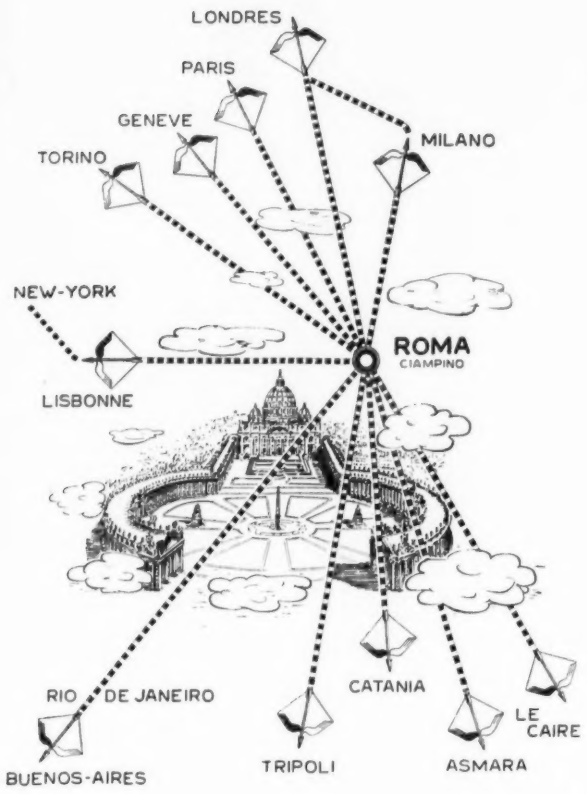


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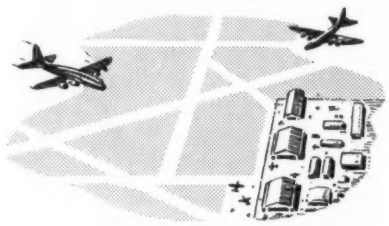

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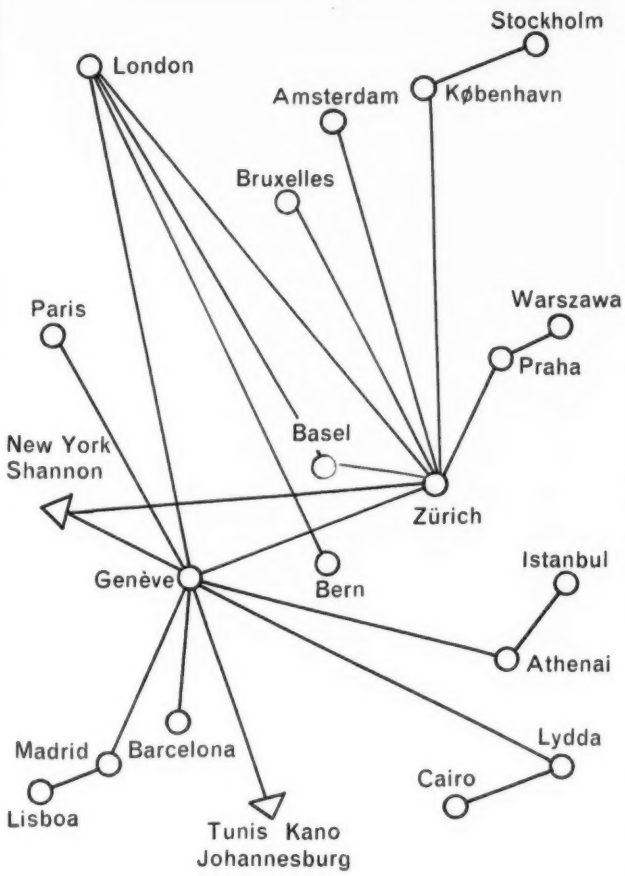


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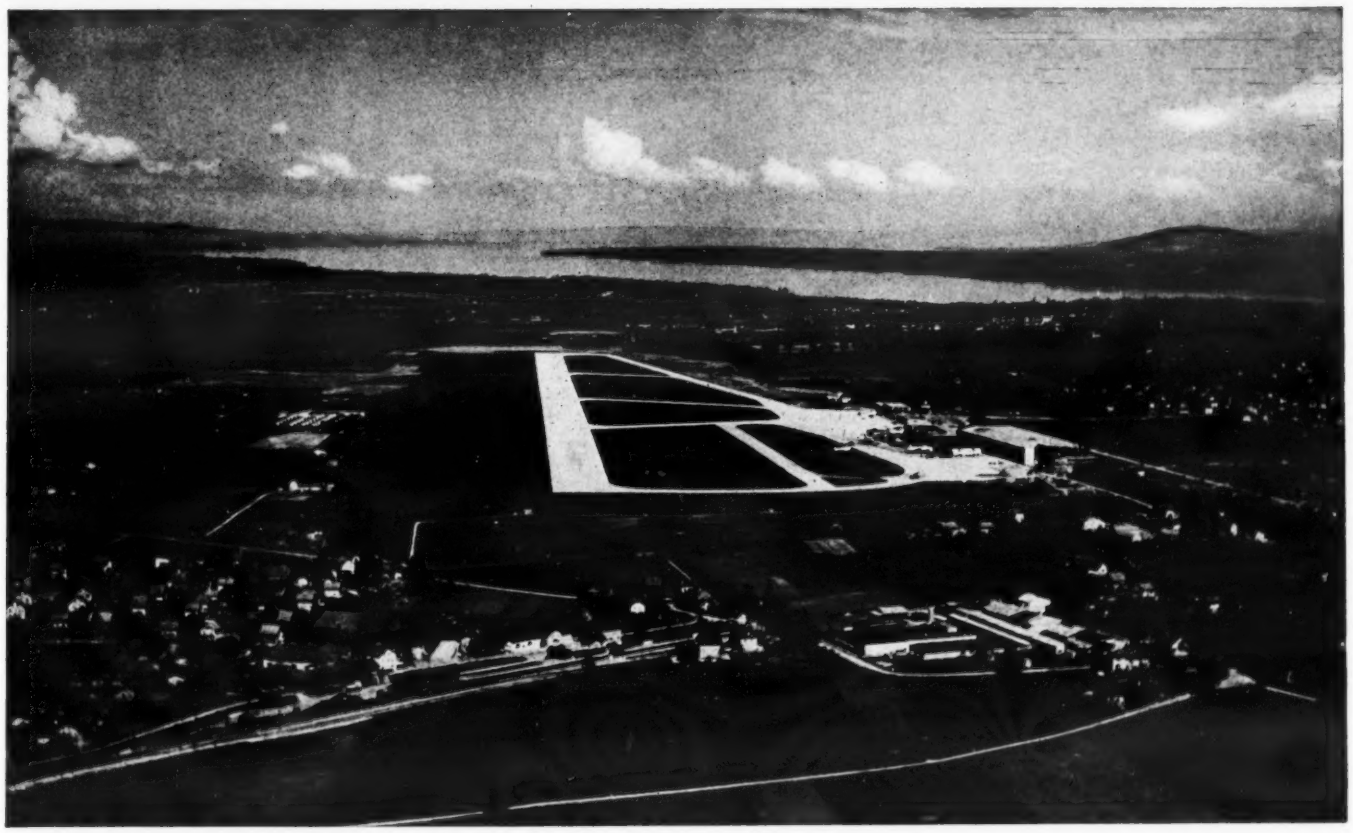

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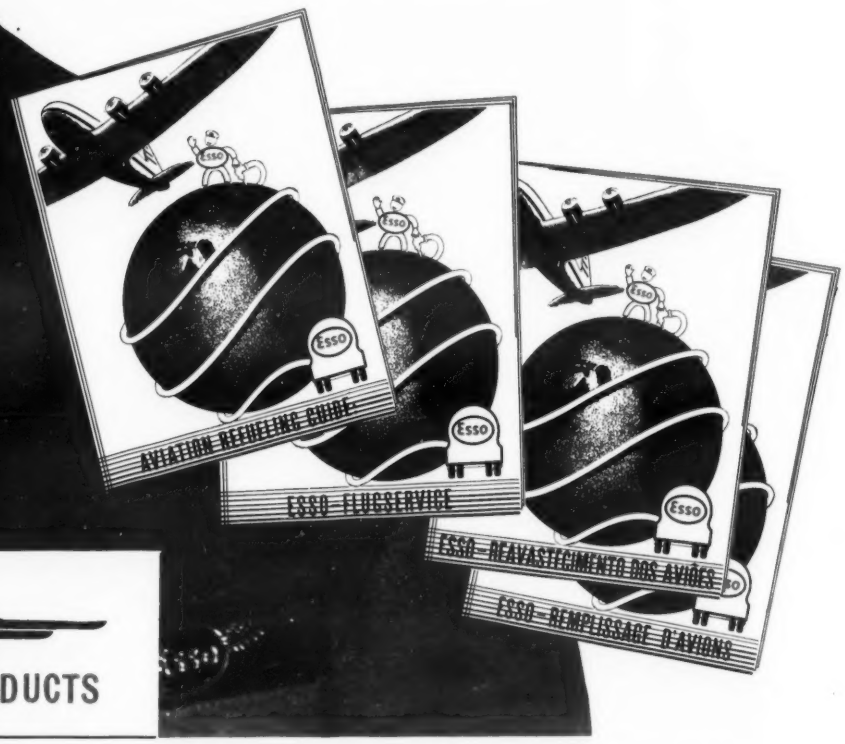


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